OL. XXIV. — No. 11. NOVEMBER 1947

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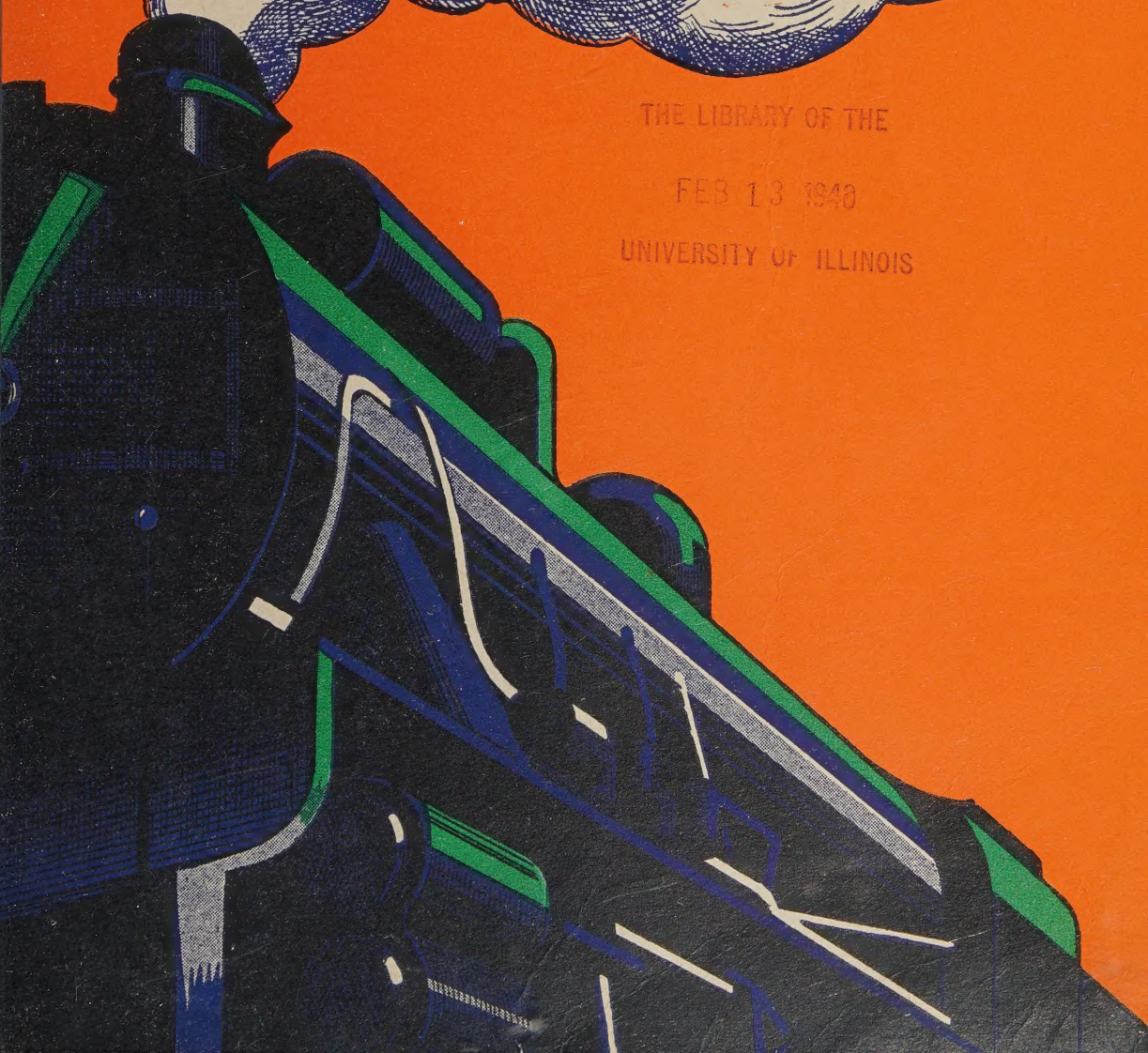
Monthly Bulletin of the International Railway Congress Association

(English Edition)



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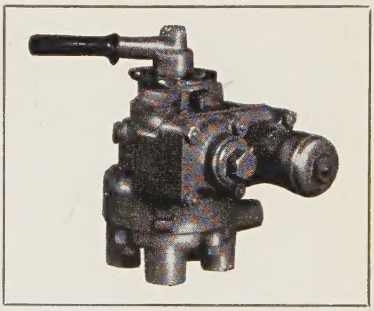
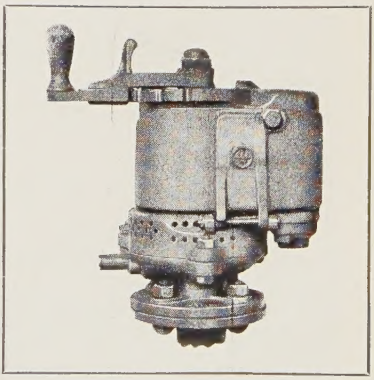
BRAKES FOR DIESEL RAIL CARS





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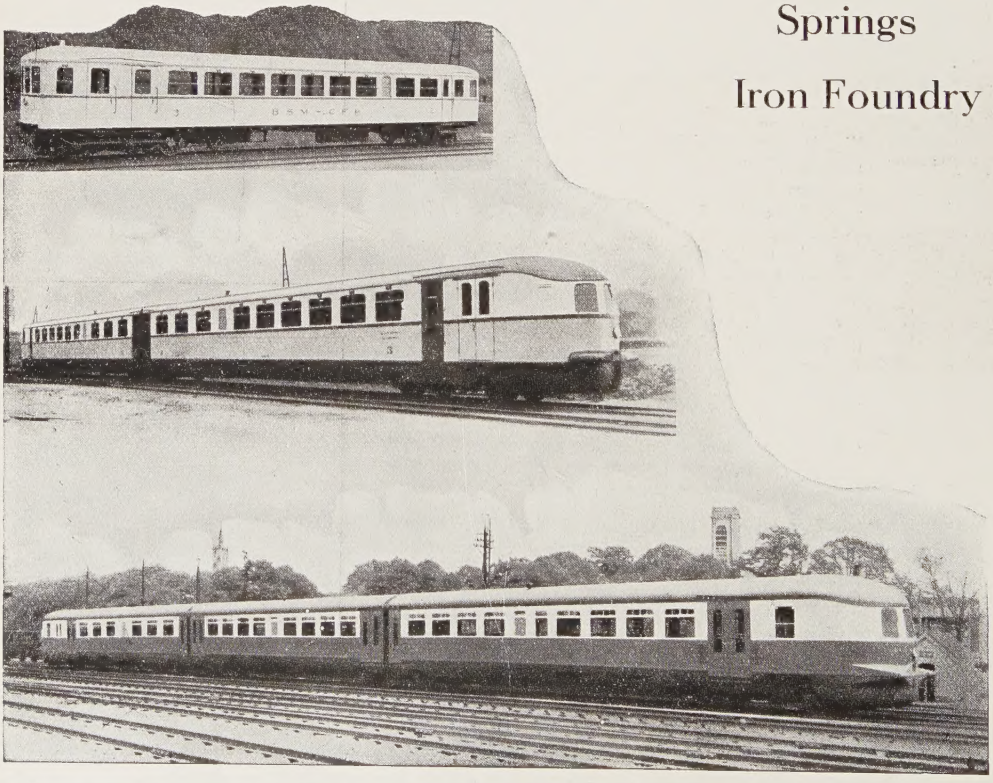

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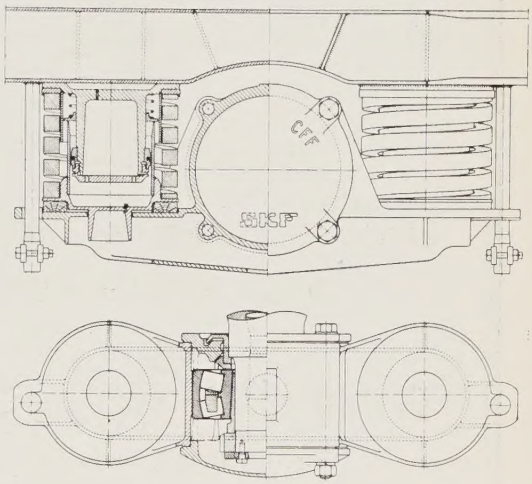

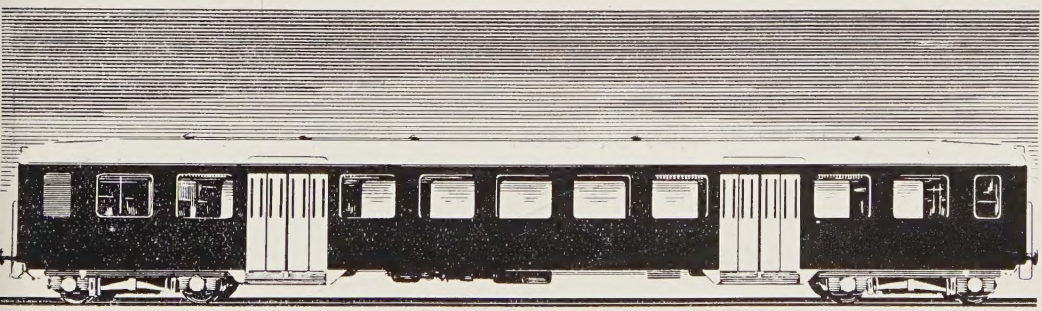

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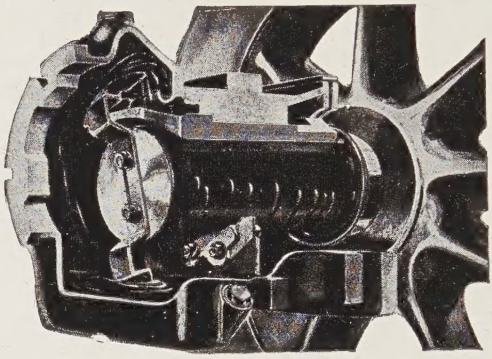

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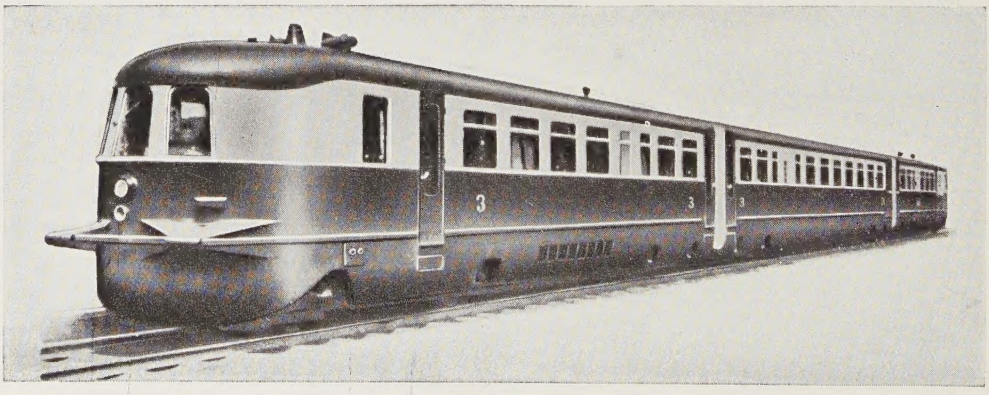
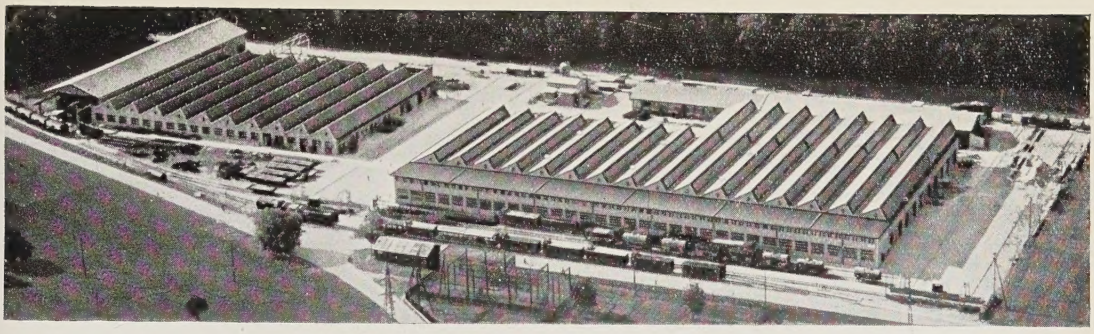
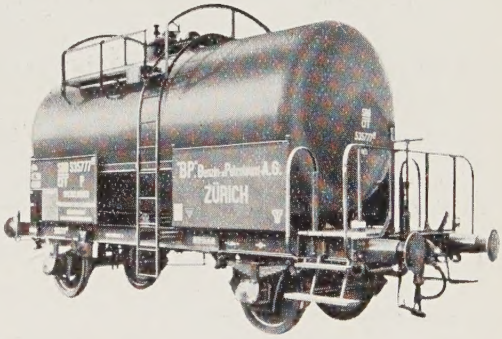
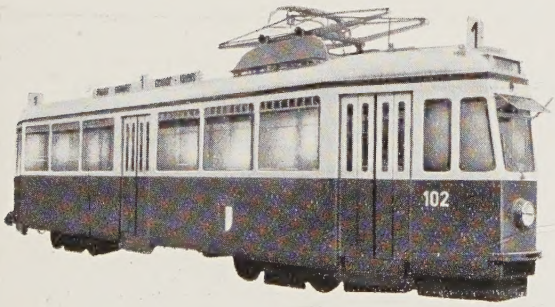
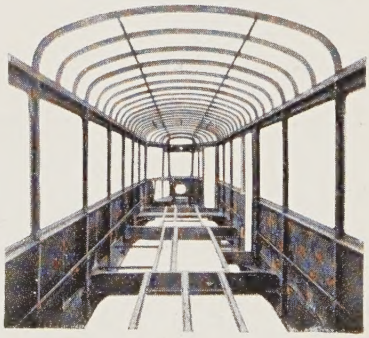


Carriages of every class and description. — Railcars, steam, electric, diesel oil locomotives. — Ordinary and special waggons. — Caboose cars and brake vans. — Tenders. — Crossings, switches and track material. — Boiler and plate work. — Forgings. — Heavy flanging.









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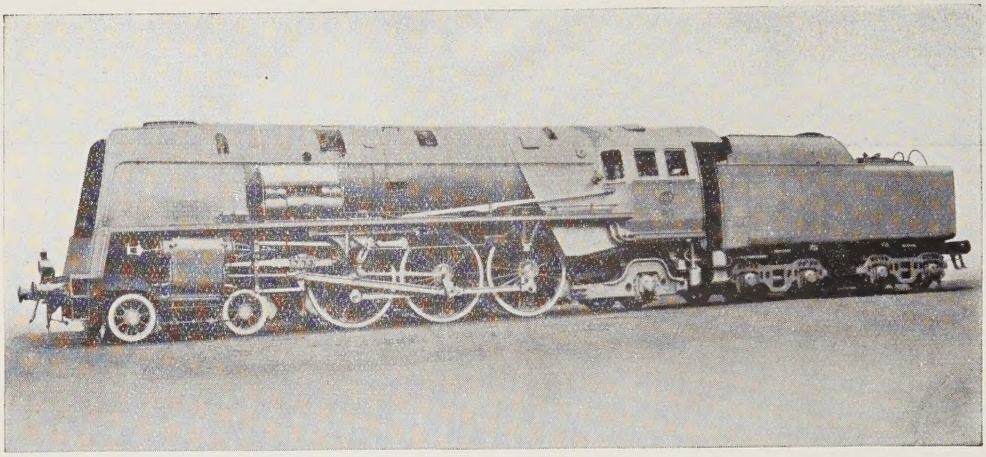

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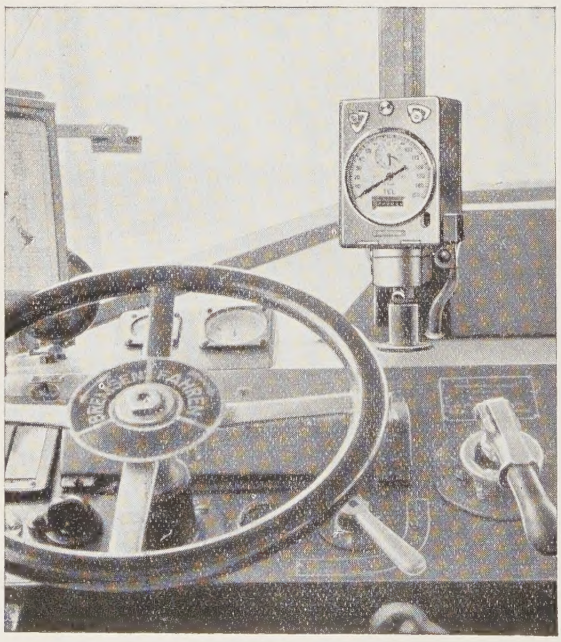
MACHINERY and METAL STRUCTURES
SHIPYARD AT HOBOKEN (ANTWERP)



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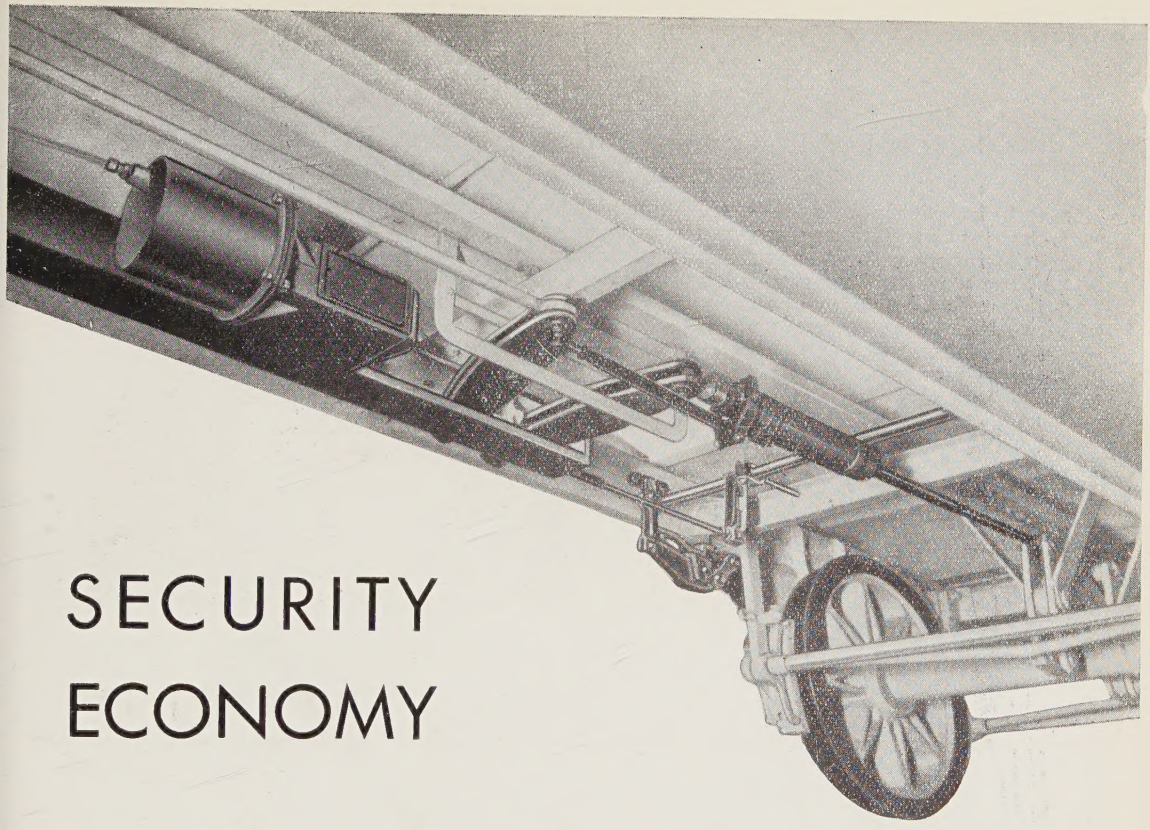

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MONTHLY BULLETIN

OF THE

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

(ENGLISH EDITION)

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An edition in French is also published.

VOL. XXIV. — No. 11. November 1947.

BULLETIN

OF THE

INTERNATIONAL RAILWAY CONGRESS

ASSOCIATION

(ENGLISH EDITION)

[385. (06 .112]

FOURTEENTH SESSION

Lucerne, 23 - 28 June 1947

GENERAL PROCEEDINGS

1st. Section : WAY AND WORKS

INAUGURAL MEETING

June 25th, 1947, at 9.30 a. m.

PROVISIONAL CHAIRMAN : MR. F. Q. DEN HOLLANDER,
MEMBER OF THE PERMANENT COMMISSION OF THE ASSOCIATION.

— The Meeting opened at 9.30 a.m.

The Chairman. — Gentlemen, the Permanent Commission of the Association requested me to preside over the inaugural meeting of the 1st Section and to make up its Secretariat.

On behalf of the Permanent Commission, I suggest that Col. Eric GORE BROWNE, Chairman of the Southern Railway, be elected as *President. (Applause.)*

As *Vice-Presidents,* I propose to appoint :

Mr. E. KAHRA, Governmental Councellor and Chief of the Chancellery (Finland);

Dr. H. J. NICHOLS, Member Engineering, Railway Board of India;

Mr. Ing. F. CHENAUX, Director of the 1st District of the Swiss Federal Railways;

Mr. I. KURANER, President of the Permanent Way Department of the Railways and Ports of the Turkish State.

and as *Principal Secretary :*

Mr. J. DUBUS, Chief Engineer at the General Direction of the Belgian National Railways. *(Marks of approval and applause.)*

— The Section following the President's proposal subsequently completed its Bureau and drew up a provisional agenda.

Revision of the Rules and Regulations of the International Railway Congress Association.

PRESIDENT : MR. F. Q. DEN HOLLANDER.

The President. — Gentlemen, before dealing with Question I, we have in compliance with Article 21 of the Rules and Regulations to appoint a delegate to the Special Committee entrusted with the examination of the proposed alteration of the Article 17 of the Rules and Regulations with regard to the amount of the annual subscriptions.

— *The proposed alterations were read out.* (*)

I suggest that Mr. Geoffrey B. BARTON, Engineer, London & North Eastern Railway, be appointed in this capacity. *(Approval.)*

— *The Section then passed on to the discussion of Question I.*

(*) See the wording of the proposed alterations of the Rules and Regulations page 803 of the *Bulletin of the International Railway Congress Association*, number of August 1947. (Summary of proceedings, Lucerne Congress, 1947.)

[625 .142]

QUESTION I.

Sleepers :

a) **different types;**
b) **maintenance methods;**
c) **financial comparison.**

Preliminary documents.

Report (Belgium and Colony, Bulgaria, Denmark, Spain, Finland, France and Colonies, Greece, Hungary, Italy, Luxemburg, Norway, Netherlands and Colonies, Poland, Portugal and Colonies, Rumania, Sweden, Switzerland, Czechoslovakia, Turkey and Jugoslavia), by O. LEDUC. (See *Bulletin*, March 1947, p. 361, or special issue No. 9.)

Report (America, Great Britain, Dominions, Protectorates and Colonies, India, China and Egypt), by J. C. L. TRAIN. (See *Bulletin*, January 1947, p. 49, or special issue No. 5.)

Special Reporter : J. VAN RIJN. (See *Bulletin*, April 1947, p. 481.)

DISCUSSION BY THE SECTION.

Meeting held on the 25th June 1947.

COL. ERIC GORE BROWNE IN THE CHAIR.

The President. — Gentlemen, first of all I wish to thank the Meeting for the honour of being nominated President of this Section. I would also like to thank the Reporters, especially Mr. TRAIN for the amount of work he has done as reporter for the English speaking countries.

As you know our common aim, in times of peace as well as in times of war, is to find the best operating conditions for railways. I would like to recall that during the war in particular Mr. TRAIN acquired great experience in connection with the track, as his railway was much exposed to attack from the air. For six years, he had to meet very difficult situations.

I am sure, Gentlemen, that the most happy relations will follow from the links we have now forged.

I formally declare the Meeting open and call upon Mr. VAN RIJN, *the Special Reporter*, to read the Summaries.

Mr. Van Rijn, *Special Reporter* (in French). — *Summary No. 1.*

1. Of the various types of sleepers, the wood sleeper is till far and away the most widely used. Soft and resinous woods are used as well as hardwoods; the railway's choice of timber varies according to the resources of the country and economic circumstances.

Each system has adopted dimensions and conditions of supply to meet its requirements; such dimensions and specifications do not differ very much as a general rule.

The President. — Has anyone anything to say about this first Summary ?

— Summary No. 1 was adopted without discussion.

Mr. Van Rijn, *Special Reporter* (in French). — *Summary No. 2.*

2. After natural or artificial seasoning, it is desirable to impregnate wood sleepers by means of some antiseptic product, which prevents rot and appreciably lengthens their life. The most widely used and most effective product is tar oil or creosote. Impregnation should preferably take place in the railway shops at the same time as the sleepers are adzed and bored, as then the work is more likely to be properly done.

The President. — Gentlemen, are we agreed upon the wording of this Summary ?

Mr. Leduc, *Reporter* (in French). — Mr. President, I think it would be advisable to point out the interest there is in investigating substitutes for creosote.

During the war there was a shortage of creosote in certain countries. It is permissible to think — as I pointed out in my report — that there may be another shortage of creosote, and I think it would be a good thing to underline the value of continuing to investigate these substitute products.

For this purpose I suggest the following wording, which I have just drawn up, to be inserted in Summary 2 after the sentence : « The most wildely used and most effective product is tar oil or creosote. » :

« It would appear to be of value to continue the investigations and trials of substitute products for creosote. »

Mr. Julien, *Ministry of Public Works and Transport, France* (in French). — I should like it to be made quite clear that the recommendation to have the impregnation done in the railway shops is simply a recommendation and not intended to exclude formally impregnation by industrial concerns, which are often well equipped and in general satisfactory.

Mr. Van Rijn (in French). — The wording of the Summary states that the impregnation should *preferably* take place...

Mr. Julien (in French). — Agreed, but I wanted to make this point quite clear during the discussion.

Mr. Dubus, *Principal Secretary* (in French). — Does everyone agree to the wording of Summary 2 amended as suggested by Mr. LEDUC, with the wording suggested by him ?

— Summary No. 2 was adopted with the amendment suggested by Mr. LEDUC. The final wording is as follows :

« 2. After natural or artificial seasoning, it is desirable to impregnate wood sleepers by means of some antiseptic product, which prevents rot and appreciably lengthens their life. The most widely used and most effective product is tar oil or creosote. It would be interesting to study more deeply substitute products for creosote. Impregnation should preferably take place in the railway shops

at the same time as the sleepers are adzed and bored, as then the work is more likely to be properly done. »

Mr. **Van Rijn** (in French). — *Summary No. 3 :*

3. The method used to fasten the rail to wood sleepers plays an important part in the conservation of the latter; mechanical wear of the sleeper where it comes into contact with the rail, together with rot, is in fact the main cause of deterioration. On many Railways flat bottomed rails are laid directly on the sleepers and secured by means of spikes or coachscrews with good results; for lines with heavy traffic or where there are small radius curves, the use of sole plates with direct fastenings, or better still indirect fastenings, is likely to prolong the life of the sleepers appreciably. Chairs have to be used with bullheaded rails.

Mr. **Demaux**, *French National Railways* (in French). — I would like to mention that in the Northern Area of the French National Railways, we used rubber pads first of all for maintenance reasons. Our experience goes to show that if rubber pads are used on all the sleepers when the line is first laid, this will appreciably lengthen the life of the sleepers, as the sleeper will not deteriorate so much under the rail, and the rubber pads last a very long time, as experience proves. In practice, when the rails are scrapped on account of wear it is found that the rubber pads under the rails are still in very good condition and can be used again.

Consequently, I think it would increase the life of the track — if it was financially and materially possible — if rubber pads were used from the start.

The President. — I think it would be very interesting if other delegates would let us have their opinions.

Mr. **Mundt**, *Netherlands Railways.* — Similar rubber pads have been used in Holland and we experienced certain difficulties owing to the fact that the rubber is in contact with the creosote used as preservative. This forced us to the conclusion that it was necessary to use a special kind of rubber. We prefer to use compressed wood instead of rubber pads.

The President. — Are there any other remarks about Summary No. 3 ?

Mr. **Nizam Ud Din**, *H.E.H. the Nizam's State Railway, India.* — I should like to know what is meant by direct and indirect fastenings and would be much obliged if the Special Reporter would explain this to me.

Mr. **Van Rijn** (in French). — Direct fastening is when the rail is fixed to the bearing plate and sleeper by means of a coachscrew or spike; indirect fastening when sleeper clips are used.

Mr. **Nizam Ud Din.** — I thank the Special Reporter for his explanation.

Mr. **Train**, *Reporter.* — This is illustrated in Mr. Leduc's Report.

Mr. **Leduc** (in French). — Here is an amended wording which Mr. Parisot of the Tunisian Railways has just handed me :

« On the French National Railways, before the war, rubber pads were used on a large scale for maintenance purposes in order to prevent the sleepers creeping; experience shows that rubber wears very slowly and certainly slower than wood. It is therefore question whether it would not be advisable to

place rubber pads under the rails from the start. Naturally the supply position and the price must be taken into account. »

Mr. Dubus (in French). — I think M. PARISOT's summary should be given in full in the report of the meeting, and Mr. VAN RIJN's Summary should remain as it is.

Mr. Parisot, *Tunisian Railways* (in French). — Agreed.

Mr. Leduc (in French). — Mr. President, would it not be of interest to mention in the text the possibility of using pads made either of rubber or some other substance ?

The President. — Does everyone agree that the wording of the Summary should remain unaltered ?

As there are certain differences of opinion, we might include the text which Mr. LEDUC has just read in the report of the work of the Section. Consequently, we would not alter the wording of Summary No. 3.

Mr. Dubus (in French). — Mr. LEDUC suggested to me that we should include the following sentence in Summary No. 3 :

« The placing of pads of special wood or preferably of rubber between the rail and the sleeper has given good results on certain railways. »

The President. — Does everyone agree to the wording of Summary 3, the text being completed by Mr. LEDUC's amendment ? *(Signs of assent.)*

Consequently we will now go on to *Summary No. 4 :*

Mr. Van Rijn (in French). — *Summary No. 4 :*

4. Metal sleepers are as good as wood sleepers from the point of view of strength and life. They are preferable in tropical countries where wood perishes very quickly.

It would seem preferable to fasten the rails by means of sole plates or chairs welded to the sleepers rather than make use of direct fastenings with clips or spikes and bolts.

Mr. Saldanha, *Great Indian Peninsula Railway, India.* — I do not agree to the second sentence of Summary 4. It is in fact easier to fasten the rail directly onto the sleeper. I cannot therefore agree with the wording of the summary which states that it is better to fix the rail to the sleeper through the intermediary of a plate welded to the sleeper.

Mr. Train. — The question is a controversial one. In order to solve the problem we need more information on this point from railways who fasten their rails directly on the sleepers. To meet the wishes of all the delegates I propose to modify slightly the wording of Summary 4.

Mr. Fenton, *East Indian Railway, India.* — The arrangement used in India is very similar to the Ougrée-Marihaye type of direct fastening of rails on metal sleepers described in Mr. LEDUC's Report on page 417 of the March 1947 *Bulletin*. In this system the rails are fastened by means of hooks which fit into slots in the sleepers and these hooks hold the rail flange tight by means of a long key-shaped cotter pin as shown in the diagram (Fig. 17) illustrating the description.

For my part, I am in favour of this method, which I have myself used for a long time on a large scale.

The pressure of this cotter pin against the rail is rather strong. However, I prefer this solution to those in which the rail is fastened by means of sleeper clips.

Mr. Oudotte, *French National Railways* (in French). — I should like to draw the attention of the Section to the previous paragraph : « Metal sleepers are as good as wood sleepers from the point of view of strength and life. »

This would seem to imply that metal and wood sleepers are used to the same extent. Now, wood sleepers have undoubted advantages over metal sleepers as regards sound, insulation and resilience. They also facilitate accurate maintenance work. Under these conditions, it appears somewhat anomalous to leave the wording as it stands.

From the point of view of strength and life, wood and metal sleepers may be placed on the same level but the wood sleeper has other properties giving same more greater value than the metal sleeper, and, as I have just said, if the text is read rapidly it seems to place the two on an equal footing, though I do not think this is the opinion of the Section.

Perhaps, if you think it a good thing, we might correct Summary 4 by simply saying : « Metal sleepers are *nearly* as good as wood sleepers from the point of view of strength and life », which makes a distinction between the two.

Mr. Nizam Ud Din. — In India the results obtained with metal sleepers are much better than with wood sleepers.

I shall refer to one case of steel sleepers laid in 1894, which were taken out of the track recently, not because of their weakness but because the rails needed relaying.

Therefore, I am of the opinion that metal sleepers is decidely superior to the wood sleeper, even from the point of view of strength. In India, its life is three times that of wood sleepers.

Mr. Julien (in French). — This is mentioned in the Summary which states: « They are preferable in tropical countries. » We are all agreed about this.

The President. — We are in very deep waters here. Can any other delegates tell us what they think about this question ?

Mr. Lamalle, *Permanent Commission of the Association* (in French). — Gentlemen, I simply must say something when I hear the statement that the manifest superiority of wood sleepers over metal sleepers should be mentioned in the Summary.

The wood sleeper has obviously not lost its advantages, but the metal sleeper seems to be gradually gaining ground, and it is possible that if the last war had not occurred, the metal sleeper would have been much more widely used.

I would like to draw the attention of the Section to the second paragraph of Summary 4 : « It would seem preferable to fasten the rails by means of sole plates or chairs welded to the sleepers rather than make use of direct fastenings with clips or spikes and bolts. »

The up-to-date metal sleeper with a welded sole plate fastened with bolts, inverted clips, the head of the bolt being anchored in grooves in the bearing plate, enables the rail to be fastened so tightly

that it remains under stress and cannot expend freely.

In addition the flange of the rail is fastened so securely to the sleeper that it becomes one with the sleeper. Consequently creep is reduced as well.

It can therefore be said in favour of the modern metal sleeper with welded sole plates and an up-to-date method of fastening, that it makes possible the use of very long rails — 27 m. (88′7″) and longer. Consequently the number of joints is reduced, the comfort of passengers is increased, and wear of the stock reduced.

Mr. Train. — After considering all the replies received from the different railways, I found it impossible to draw up a summary which would please everyone. I think we should keep the wording suggested by Mr. OUDOTTE, and state that metal sleepers are nearly as good as wood sleepers, seeing that in the following sentence mention is made of the fact that metal sleepers are the best in tropical countries where wood sleepers deteriorate very fast.

The President. — Does everyone agree, Gentlemen ?

Mr. Leduc (in French). — I am astonished that no one has pointed out the difficulty of using metal sleepers on lines equipped with track circuits. I think that this is one of the great drawbacks to metal sleepers on main lines.

The President. — Does the Section agree that the word « *nearly* » should be included ?

Mr. Saldanha. — In order to settle the question and make a compromise, I suggest wording the summary as follows : « Metal sleepers can be used instead of wood sleepers with complete satisfaction from the point of view of strength and life. »

In this way we avoid saying that they are better or not so good.

The President. — Does everyone agree to this wording ?

Mr. Julien (in French). — What is the actual wording ? We might say : « Metal sleepers can replace wood sleepers from the point of view of strength and life. »

Mr. Dubus (in French). — Mr. SALDANHA wanted the following wording : « ... can quite satisfactorily replace... »

Mr. Julien (in French). — We must have a definite statement.

Mr. Dubus (in Frensh). — Will you draw up the wording in French Mr. LEDUC ? We will translate it.

Mr. Julien (in French). — We might say : « Metal sleepers can replace wood sleepers from the point of view of strength and life. »

Mr. Leduc (in French). — Adding, as I said just now : « Except on lines equipped with track circuits. »

Mr. Julien (in French). — Agreed.

Mr. Leduc (in French). — This summary is important from the point of view of making a comparison between wood and metal sleepers.

Mr. Van Rijn (in French). — We must add : « They cannot be used on lines equipped with track circuits. »

The President. — Gentlemen, I suggest that some of you meet together in order to find a wording which will please everyone, to be submitted to to-morrow's meeting.

Any objections ?

(The Section agreed to this.)

Mr. Van Rijn (in French). — *Summary No. 5.*

5. Concrete sleepers are not yet widely used, though certain types made of ordinary reinforced concrete have given good results; present research would seem to be concentrating on prestressed concrete. The fastening of the rail to concrete sleepers is still a difficult problem.

The President. — Does everyone agree to this wording ? *(Agreed.)*

Mr. Van Rijn (in French). — *Summary No. 6.*

6. The conservation of the sleepers depends to a large extent on the maintenance of the correct level of the track. This maintenance can be carried out either by tamping, by hand or mechanically, or by measured shovel packing. The latter gives excellent results, and is being more and more used.

The repair of defective fastenings by the appropriate means is another essential factor for prolonging the life of sleepers; such repairs usually are made in conjunction with re-adzing, recutting the shoulders, and repairing any splits.

Owing to the present shortage of labour, the use of mechanical methods for all maintenance work is to be greatly recommended.

Mr. Leduc (in French). — I should like some information from the representatives of the Italian Railways regarding this question. The Italian Railways stated that after making trials of measured shovel packing, they gave it up but did not give any reasons for this. I think there must be some representative of the Italian State Railways here who could explain why this was.

Mr. Lasz, *Italian State Railways* (in French). — We made trials of measured shovel packing on our railway, but we had to give up this method owing to a shortage of suitable ballast for our lines, or owing to the fact that mechanical methods were used for maintenance work.

Mr. Leduc (in French). — The Algerian Railways also reported that after having used measured shovel packing, they went back to tamping. They gave the following reasons : the small amount of traffic on their lines; the great differences in temperature occurring in Algeria, and the general use of 36 m. (118′ 1¼″) rails. It seems to me that these reasons are insufficient for giving up a method which according to our experience gives definitely good results.

— There was no representative of the Algerian Railways amongst the delegates to reply to this objection.

Mr. Wallace, *London Midland & Scottish Railway.* — On the L.M.S. we continued to use measured shovel packing throughout the war and we have no intention of giving up this practice. It conserves all the necessary resilience and solidity of the track.

Mr. Mundt. — I think that to some extent we have neglected to strengthen our permanent way. The use of heavier rails spreads the load better over the sleepers. On the other hand, in tropical

countries in particular, the fact that the sleepers are covered with ballast protects them from the sun and prevents them splitting.

The President. — Does everyone agree to the wording of *Summary No. 6 ? (Agreed.)*

Consequently Mr. VAN RIJN will now read *Summary No. 7.*

Mr. Van Rijn (in French). — *Summary No. 7.*

7. Maintenance of metal sleepers in the track is limited to tightening up the fastenings. Repairs to cracks by welding and the replacement of the sole plates can only be done when the sleepers are taken up.

The only maintenance operation possible with concrete sleepers is the replacement of the fastenings.

— This Summary was adopted without discussion.

Mr. Van Rijn (in French). — *Summary No. 8.*

8. When its appreciably shorter life is taken into account, the softwood sleeper, in spite of its lower first cost, costs more per year of service than a hardwood sleeper.

Although the information supplied by the different Railways does not make it possible to say so definitely, it would appear that, leaving aside those countries rich in timber, the cost of impregnating sleepers is made good by their longer life.

The use of metal sole plates, especially with indirect fastenings, prolongs the life of wood sleepers, but the figures supplied do not make it possible to conclude that there is a definite economic advantage to be obtained thereby.

In steel producing countries, the metal sleeper may compete with the wood sleeper from the point of view of annual cost.

It is not yet possible to give any definite opinion from a financial point of view concerning concrete sleepers, if, they can be given a sufficiently long life by careful manufacture and a suitable method of fastening, their annual cost may be lower than that of wood or metal sleepers.

Mr. Levi, *French National Railways* (in French). — As regards the third paragaph, I think the wording is rather too absolute, as it seems to imply that metal sole plates are the one means of reducing repair costs or sleeper replacements, whereas they are not the only method to be considered from this point of view. Resilient pads can do the same as well as the usual fastenings when they prevent the rail hammering on the sleeper, for example the elastic spikes already used in America and Great Britain.

I think therefore that we should not say that the use of metal sole plates may result in savings in sleeper maintenance, but all devices which reduce the action of the rail on the sleepers.

Mr. Saldanha. — If possible, I should like to include in the final paragraph a statement to the effect that concrete sleepers are better on narrow gauge lines.

The President. — Gentlemen, are there any other remarks about Summary No. 8 ?

I suggest that in order to meet the wishes of the two delegates who made remarks about the third and fifth paragraphs of Summary 8 a new wording should be drawn up and considered during the meeting to-morrow.

Mr. Julien (in French). — I further suggest that we add to Summary No. 8 a sentence stating that at present concrete sleepers cost more than metal or wood sleepers.

Mr. Dubus (in French). — Mr. Julien's remark about the high cost of concrete sleepers could be included in the last paragraph.

Mr. Julien (in French). — That is so; I agree.

The President. — Gentlemen, as I said just now, to-morrow we will put before the meeting the final wording of certain paragraphs of the Summaries, which have to be revised to take into account the remarks made during the discussions.

Before the meeting breaks up, I want to thank you all for your valuable collaboration in the discussions.

— The Meeting adjourned at 11.30 a.m.

Meeting held on the 26th June 1947.

M. F. CHENAUX, the Vice-President, in the chair.

— The Meeting started at 9.45 a.m.

The President (in French). — As the President of our Section, Colonel Eric Gore Browne is unable to attend this meeting, I as Vice-President, have the honour of presiding over to-day's meeting.

During yesterday's meeting, certain objections were raised regarding Summaries, Nos. 2, 3, 4, 5 and 8.

In the meantime, a new wording has been drawn up which will now be read to you. I call on Mr. Dubus, *Principal Secretary*.

Mr. Dubus (in French). — Gentlemen, I will only read you the summaries to which alterations have been made.

Summary 1. — Remains as it is.

Summary 2. — An addition to the original text was agreed upon yesterday. The summary now reads :

« 2. After natural or artificial seasoning, it is desirable to impregnate wood sleepers by means of some antiseptic product, which prevents rot and appreciably lengthens their life. The most widely used and most effective product is tar oil or creosote. »

Here we add :

« It would be interesting to study more deeply substitute products for creosote. »

Then we continue with the original wording :

« Impregnation should preferably take place in the railway shops at the same time as the sleepers are adzed and bored, as then the work is more likely to be properly done. »

Summary 3. — The wording has been slightly altered. Here is the new wording :

« 3. The method used to fasten the rail to wood sleepers plays an important part in the conservation of the latter; mechanical wear of the sleeper where it comes into contact with the rail, together with rot, is in fact the main cause of deterioration. On many Railways flat

bottomed rails are laid directly on the sleepers and secured by means of spikes or coachscrews with good results; for lines with heavy traffic, or where there are small radius curves, the use of sole plates with direct fastenings, or better still indirect fastenings, is likely to prolong the life of the sleepers appreciably. Chairs have to be used with bullheaded rails. »

Here we add the following :

« The placing of pads made of special wood or preferably of rubber has produced interesting results on some systems. »

Summary 4. — The first paragraph has been altered as follows :

« 4. From the point of view of strength and life, metal sleepers can replace wooden sleepers except, of course, where track circuiting is involved. They are preferable in tropical countries where wood perishes very quickly. »

Then comes the second paragraph :

« It would seem preferable to fasten the rails by means of sole plates or chairs welded to the sleepers rather than make use of direct fastenings with clips or spikes and bolts. »

Summary 5. — There is a slight alteration here, one word being added :

« 5. Concrete sleepers are not yet widely used, though certain types made of ordinary reinforced concrete have given quite good results; present research would seem to be concentrating on prestressed concrete. The fastening of the rail to concrete sleepers is still a difficult problem. »

Summary No. 6. — Maintained in its original form.

Summary No. 7. — Maintained in its original form.

Summary No. 8. — The third paragraph has been completed by an additional sentence and the last paragraph has been slightly altered.

The new wording is as follows :

« 8. When its appreciably shorter life is taken into account, the softwood sleeper, in spite of its lower first cost, costs more per year of service than a hardwood sleeper.

« Although the information supplied by the different Railways does not make it possible to say so definitely, it would appear that, leaving aside those countries rich in timber, the cost of impregnating sleepers is made good by their longer life.

« The use of metal sole plates, especially with indirect fastenings, prolongs the life of wood sleepers, but the figures supplied do not make it possible to conclude that there is a definite economic advantage to be obtained thereby. »

This paragraph is completed by the following addition :

« The same applies to every device capable of reducing the hammering of the rail on the sleeper. »

We then continue with the original wording :

« In steel producing countries, the metal sleeper may compete with the wood sleeper from the point of view of annual cost.

« It is not yet possible to give any definite opinion from a financial point of view concerning concrete sleepers... »

Here, we add :

« the present cost of manufacture of which is high »,

then continue with the original text :

« If they can be given a sufficiently long life by careful manufacture and a suitable method of fastening, their annual cost may become lower than that of wood or metal sleepers. »

The President. — Can I take it that you are all agreed on the wording of the Summaries as just read, which will be put before the Plenary Meeting to-morrow ?

(The Section approved them unanimously.)

Gentlemen, before we end the meeting, you are invited to see a film on the construction and maintenance of the permanent way, which will be shown by Mr. Train.

Before we part, I should like once more to thank the Reporters for their work, as well as the delegates who took part in the discussions.

— The Meeting ended at 10.20 a.m.

DISCUSSION AT THE PLENARY MEETING.

Meeting held on the 27th June 1947.

DR. W. MEILE, PRESIDENT, IN THE CHAIR.
GENERAL SECRETARIES : MR. P. GHILAIN AND DR. G. DREYER.
ASSISTANT GENERAL SECRETARY : MR. EYRE A. W. TURBETT.

The President. — Gentlemen, our agenda to-day includes an examination of the Summaries adopted in the different Sections. Will the General Secretary please read these to us.

Mr. Ghilain, *General Secretary.* — The text of the Summaries for the Question I was published in the *Daily Journal of the Congress*, No. 4 of the 27th June.

(Mr. GHILAIN then read the summaries one by one.)

— As no objections were raised, these Summaries were adopted.

Summaries.

« 1. Of the various types of sleepers, « the wood sleeper is still far and away « the most widely used. Soft and resinous woods are used as well as hard- « woods; the railway's choice of timber « varies according to the resources of « the country and economic circumstances.

« Each system has adopted dimensions « and conditions of supply to meet its « requirements; such dimensions and « specifications do not differ very much « as a general rule.

« 2. After natural or artificial season- « ing, it is desirable to impregnate wood « sleepers by means of some antiseptic « product, which prevents rot and ap- « preciably lengthens their life. The « most widely used and most effective « product is tar oil or creosote. It « would be interesting to study more « deeply substitute products for creosote. « Impregnation should preferably take « place in the railway shops at the same « time as the sleepers are adzed and bored, as then the work is more likely to « be properly done.

« 3. The method used to fasten the rail « to wood sleepers plays an important « part in the conservation of the latter; « mechanical wear of the sleeper where « it comes into contact with the rail, « together with rot, is in fact the main « cause of deterioration. On many Railways flat bottomed rails are laid directly « on the sleepers and secured by means « of spikes or coachscrews with good « results; for lines with heavy traffic, or « where there are small radius curves, « the use of sole plates with direct fastenings, or better still indirect fastenings, is likely to prolong the life of the « sleepers appreciably. Chairs have to « be used with bullheaded rails. The « placing of pads made of special wood « or preferably of rubber has produced « interesting results on some systems.

« 4. From the point of view of « strength and life, metal sleepers can « replace wooden sleepers except, of « course, where track circuiting is in- « volved. They are preferable in tro- « pical countries where wood perishes « very quickly.

« It would seem preferable to fasten « the rails by means of sole plates or « chairs welded to the sleepers rather « than make use of direct fastenings with « clips or spikes and bolts.

« 5. Concrete sleepers are not yet « widely used, though certain types made « of ordinary reinforced concrete have « given quite good results; present re- « search would seem to be concentrating « on prestressed concrete. The fasten- « ing of the rail to concrete sleepers is « still a difficult problem.

« 6. The conservation of the sleepers « depends to a large extent on the main- « tenance of the correct level of the track. « This maintenance can be carried out « either by tamping, by hand or mechan- « ically, or by measured shovel packing. « The latter gives excellent results, and « is being more and more used.

« The repair of defective fastenings by « the appropriate means is another es- « sential factor for prolonging the life of « sleepers; such repairs usually are made « in conjunction with re-adzing, re-cut- « ting the shoulders, and repairing any « splits.

« Owing to the present shortage of la- « bour, the use of mechanical methods « for all maintenance work is to be « greatly recommended.

« 7. Maintenance of metal sleepers in « the track is limited to tightening up « the fastenings. Repairs to cracks by « welding and the replacement of the « sole plates can only be done when the « sleepers are taken up.

« The only maintenance operation pos- « sible with concrete sleepers is the re- « placement of the fastenings.

« 8. When its appreciably shorter life « is taken into account, the softwood « sleeper, in spite of its lower first cost, « costs more per year of service than a « hardwood sleeper.

« Although the information supplied « by the different Railways does not « make it possible to say so definitely, it « would appear that, leaving aside those « countries rich in timber, the cost of « impregnating sleepers is made good by « their longer life.

« The use of metal sole plates, espe- « cially with indirect fastenings, pro- « longs the life of wood sleepers, but the « figures supplied do not make it pos- « sible to conclude that there is a defi- « nite economic advantage to be obtained « thereby. The same applies to every « device capable of reducing the hammer- « ing of the rail on the sleeper.

« In steel producing countries, the me- « tal sleeper may compete with the wood « sleeper from the point of view of an- « nual cost.

« It is not yet possible to give any « definite opinion from a financial point « of view concerning concrete sleepers, « the present cost of manufacture of « which is high. If they can be given a « sufficiently long life by careful manu- « facture and a suitable method of fas- « tening, their annual cost may become « lower than that of wood or metal « sleepers. »

385. (06 .112

2nd and 5th SECTIONS MEETING JOINTLY:

2nd Section : LOCOMOTIVES AND ROLLING STOCK.
5th Section : LIGHT RAILWAYS AND COLONIAL RAILWAYS.

INAUGURAL MEETING

June 25th at 9.30 a. m.

PROVISIONAL CHAIRMAN : MR. ARMAND,
MEMBER OF THE PERMANENT COMMISSION OF THE ASSOCIATION.

— The Meeting opened at 9.30 a.m.

The Chairman. — Gentlemen, the Permanent Commission has requested me to preside over the inaugural meeting of the 2nd and 5th Sections meeting jointly, who are called to discuss together the question II on the Agenda of the Session.

On behalf of the Permanent Commission, I suggest :

Mr. A. PARMANTIER, Chef du Service technique du Matériel et de la Traction, French National Railways, be appointed as *President. (Applause.)*

To make up the bureau, I propose as *Vice-Presidents :*

Mr. J. M. RIVERO DE AGUILAR, General Director of the National System of Spanish Railways;

Mr. C. MELISSINOS, General Director of the Piraeus-Athens-Peloponnesus Railways;

Mr. T. N. Hj. RINGQVIST, Chief Engineer of the Swedish State Railways;

Mr. C. C. HEDEGAARD CHRISTENSEN, Director of the Working and Rolling Stock Departments of the Danish State Railways;

and as *Principal Secretary :*

Mr. E. MINSART, Chief Engineer of the Belgian National Railways.

(Marks of approval and applause.)

Therefore, I ask these Gentlemen — and first of all Mr. PARMANTIER — to take their seat on the platform.

— *Then* Mr. PARMANTIER *takes the Chair.*

Mr. Armand. — Gentlemen, I wish you great success in your works and also I like to bring to your notice two recommendations from our General Secretary, first to end your meetings before 1 p.m. — this I believe is an advice which will be easy to follow — and next, to discuss on accurate summaries.

In railway matters, all is in everything and vice-versa, you may for any question discuss all the principles. Our programme is much more moderate, it is to

submit to the Plenary Meeting accurate summaries on the question which we have to study. Therefore, I wish you good luck.

— The joint Sections following the proposal of the President then completed its Bureau and drew up a provisional agenda.

Revision of the Rules and Regulations of the International Railway Congress Association.

Mr. A. PARMANTIER is in the Chair.

The President. — Gentlemen, before dealing jointly with Section 5 with the examination of Question II, I have to speak to you about the proposed alterations to Article 17 of the Rules and Regulations of the International Railways Congress Association.

(The President *read out the proposed modifications.)* (*)

In accordance with Art. 21 of the Rules and Regulations, we have to appoint two of our members — one from the 2nd Section and the other from the 5th Section — to attend the meeting of the Special Committee who will examine the proposed modifications.

The Bureau suggest that

Mr. C. Melissinos, General Director of the Pireaus-Athens-Peloponnesus Railways, and

Mr. W. A. Vrielynck, Director of the Locomotives and Rolling Stock Department of the Belgian National Light Railways Company,

to be appointed as our delegates. *(Applause.)*

— The 2nd Section then met jointly with the 5th Section for the discussion of Question II.

(*) See wording of the proposed alterations in the August 1947 number of this *Bulletin*, p. 803. (Summary of Proceedings, Lucerne Congress, 1947.)

[625 .2 & 669]

QUESTION II.

Lightening the rolling stock.

Reduction in the weight of rolling stock (passenger and goods) by :

a) **choice of the method of construction;**

b) **use of special steels;**

c) **use of light alloys.**

Preliminary documents.

Report (Belgium and Colony, Bulgaria, Denmark, Spain, Finland, France and Colonies, Greece, Hungary, Italy, Luxemburg, Norway, Netherlands and Colonies, Poland, Portugal and Colonies, Rumania, Sweden, Switzerland, Czechoslovakia, Turkey and Jugoslavia), by R. GUIGNARD. (See *Bulletin*, February 1947, p. 153, or separate issue No. 6.)

Report (America, Great Britain, Dominions, Protectorates and Colonies, India, China and Egypt), by Eyre A. W. TURBETT. (See *Bulletin*, January 1947, p. 1, or separate issue No. 2.)

Report (Light Railways and Colonial Railways of all countries), by W. A. VRIELYNCK. (See *Bulletin*, February 1947, p. 245.)

Special Reporter : Mr. José DE AGUINAGA. (See *Bulletin*, April 1947, p. 487.)

DISCUSSION BY THE SECTION.

Joint Meeting held on June 25th, 1947, by the 2nd and 5th Sections.

MR. A. PARMANTIER IS IN THE CHAIR.

The President (in French). — Gentlemen, we have a very important and topical Question on the agenda for discussion to-day : the lightening of rolling stock.

To save time, I will ask the Special Reporter, Mr. DE AGUINAGA, to give a brief summary of the main points in his special report; we will then consider in turn each of his summaries.

Mr. de Aguinaga, *Special Reporter* (in French). — Mr. President, Gentlemen, the chief fact that emerges from studying the question of lightening rolling stock is that it is easier to reduce the weight of passenger coaches than goods wagons, which is quite natural in view of the simple construction of the latter, as it is always harder to alter simple things. On the other hand, the body of a coach might be said to be a sort of packing case for passenger transport, which must contain all the services the latter may need, must run comfortably, and be as safe as possible in case of accidents. This is an ambitious programme involving heavy and complicated designs; this is the reason why it is relatively easy to reduce the weight, which is a matter of great interest as coaches, even when running empty or with only a few passengers, are always running at the expense of the railway.

A great step forward was made when the body and frame came to be considered as a single unit to stand up to all stresses together. A comparison of the different solutions mentioned in the reports shows however that the differences in tare weight par m^2 of area are as much as 200 kgr. (441 lbs.). I think that this difference in the tare weight of coaches belonging to different Administrations could be substantially reduced in the future, even if not completely wiped out.

To obtain such a result it is necessary to eliminate all unnecessary weight in all the components of the coach, and with this object in view it is desirable that each Railway should advise the others of any solutions adopted, both as regards theory and practice, as well as the quality of the materials used. This is why such meetings as the present are particularly valuable on account of the opportunity offered for the exchange of ideas.

The President (in French). — I thank Mr. de Aguinaga for the report he has just given us.

If you are agreeable, we will consider in turn each of the points of the Summaries given in his report as he himself suggest, discussing the different questions arising in connection with them.

I must ask you to be as exact as possible in your statements, and you should concern yourselves not only with the materials now used, but also with those likely to be used in the future and future designs, as we are discussing not past but future practice.

PASSENGER ROLLING STOCK.

Mr. de Aguinaga (in French). — *Summary 1 :*

1. There is a general tendency towards reducing the weight of passenger rolling stock without adversely affecting its strength or the comfort it affords.

The President (in French). — This very general statement is concerned with metal rolling stock. The word « metal » has not been specified in the summary because it is obvious that this type of rolling stock is meant. I propose to amend the text so that it reads : « The tendency to lighten *metal* passenger rolling stock... »

Have you anything to say about this general statement ?

— *Adopted in the amended form suggested by the* President.

Mr. de Aguinaga (in French). — *Summary 2 :*

2. By using ordinary structural steels and

designing all components very carefully, combined with a large use of arc welding, it is possible to achieve very appreciable savings in the weight of coaches, reducing the tare to 30 to 35 tonnes (29.526 to 34.447 Engl. t.).

The President (in French). — Does anyone wish to say anything about this question ?

Mr. Legrand, *French National Railways* (in French). — I should like to make two remarks.

The first refers to the phrases : « By using ordinary structural steels... » I wonder if this is not somewhat too limiting and was intended by the Reporter to exclude kinds of steel already fairly widely used, which without being the usual structural steels, are nonetheless steels of a high tensile strength : I mean rustless steels and weldable steels containing a small proportion of some alloy, which the Reporter's wording would seem to exclude somewhat from current use at the present time.

My second remark refers to the interest I think there is in defining to some extent the phrase: « ... and designing all components very carefully... » with which I am moreover entirely in agreement. Would it not be advisable to introduce a paragraph in this Summary dealing with the design of the underframe-body structure in the form of a tubular girder in order to reduce the weight, which has a high moment of inertia and the ends of which are specially braced to resist shock ? This method of construction is much to the fore on the railways at the present time.

It seems to me therefore that it would be useful to give some details of the way in which the Administrations are studying constructional details.

This leads me to suggest that the words : « By using ordinary structural steels... » should be deleted as they are rather too limited in meaning, and a sentence should be added giving more details about the designs being studied.

The President (in French). — Has anyone anything to say about Mr. LEGRAND's remarks ?

Mr. Guignard, *Reporter* (in French). — I quite agree with what Mr. LEGRAND has said about the phrase : « By using ordinary structural steels... ». It would be better to say that it is the tubular girder form of construction of the underframe-body assembly that enables savings to be made in the weight, rather than the materials used. Such savings are not obtained by using steels of 50 to 60 kgr./mm² (31.75 to 38.09 tons per sq. inch) tensile strength instead of the usual 37, as on the French Railways.

As for the phrase : « ... combined with a large use of arc welding... », I think it would be better to mention the different methods of welding used. Actually if arc welding is perhaps the most widely used in France, resistance and spot welding are also widely used, and in Italy gas welding is also used to some extent.

On the other hand it is perhaps unnecessary to give a definite figure for the tare weight. In fact 35 t. is too low a figure for America where the tares are certainly higher, and too high for Europe as a whole. The figure might be left out, as it is not necessary to be so precise in a general Summary.

The President (in French). — Perhaps the Meeting would like to discuss Mr. GUIGNARD's remarks, beginning with the question of the tare weight.

I think everyone will agree that no figure should be given in the summary.

I think there are two interesting points which might well be discussed :

1) the comparative use of ordinary and special steels;

2) the question of welding to which Mr. Guignard alluded.

I shall be very glad to hear the opinions of members of the Meeting.

Mr. Armand, *French National Railways,* (in French). — Before we consider the subject suggested by Mr. Parmantier, i.e. the question of ordinary and special steels, I would like to ask another question.

It is stated that a reduction in weight is obtained by making the body like a tubular girder. We are therefore concerned more particularly with the body and nothing has been said about weight reduction in the case of the bogie frame.

To lighten the body, and possibly to lighten the bogies, at the present time one principle seems to emerge, quite apart from the method of construction, no matter what steel is used, and that is that endeavours are being made more and more to build up special sections or tubular forms from flats to obtain the greatest possible moment of inertia, and this, as has been stated, is done by using welding.

Fundamentally, there is a tendency which in my opinion marks the turning point in rolling stock construction; in this field as in others the foundry is being abandonned in favour of constructions using steel which can be shaped cold and which is welded to form very strong elements.

In other words, this principle which is already widely used in the case of both coaches and wagons and even in certain bogies, marks a new departure, which I think should be mentioned in the Summaries.

We say that parts are built up; it would be better to say that these components form assemblies, starting from relatively thin flats which are welded together to form very strong components.

For example, double T's or U sections which were rolled hot have often been used for certain body pillars and on wagons.

This foreshadows the tendency in future constructions to replace these relatively heavy sections by a square tube obtained by shaping the metal cold by means of welding. Such a tube with a square section will be infinitely lighter than the old sections.

I think that it was this tendency to which the Special Reporter wished to refer ? (Mr. de Aguinaga *made a sign of assent.)* I think that the constructions of the future will be based upon this method.

Obviously in the case of such constructions, in which the steel is as thin as possible, the tendency to use special steels, apparent especially in North America, will be adopted by other Administrations for two reasons. First of all some of these special steels are rustless. Now it is obvious that when relatively thick sheets and sections were used on the railway, such as those I spoke about just now, corrosion might spoil the appearance of certain parts but would not impair their strength, at least during their normal life. If, on the other hand, very thin tubes are made of steel that is likely to rust on the inside or outside, there is no doubt at all but that there is a risk of having parts of insufficient strength.

Consequently, the quality of being rust-proof, which was not necessary in the case of structural steels yesterday but which may be essential in them to-morrow, is the foremost quality of certain special steels.

Secondly we have a tendency, we who are designers of metal rolling stock, like all other metal designers, to replace hot working of steel by cold working. At the present time, it is a matter of astonishment to visit certain shops and find that practically speaking no hot work is done. The discovery of steels which can be worked cold will be in many cases the main problem for research work of the future.

When we consider the properties of 18/8 austenitic steel, the classical rustless steel, which will stand considerable deformation without losing its strength, we are bound to feel that in the future railway rolling stock will profit by the properties of this steel, as it is beginning to do in America.

We all know the difficulties experienced in making certain parts, especially those which carry the roof, in view of the fact that generally speaking with ordinary steel any shaping done cold is excessive, so that it is necessary to work the metal hot. Now 18/8 steel can easily be shaped without losing its strength, without having to heat it at all.

Moreover the use of these steels makes it possible to make surfaces which cannot be set out, that is to say the formation from a flat sheet of a surface which cannot be set out. For example the ends of coaches, the ends of railcars. All this work is what is known as boiler-work, i.e. shaping the steel by hammer; the sheet is hammered to give it the desired surface. With rustless steel such a surface can be obtained directly by passing the sheet over a former and stretching it just like a rubber sheet sufficiently to shape it. The sheet will keep this shape. In spite of being shaped in this way, the steel will not have lost any of its strength.

Gentlemen, in this brief summary I have tried to answer the question asked by the PRESIDENT. Does it not seem advisable to discuss this subject, as we are entrusted with pointing the way to the future ?

The Reporters, to whom many thanks, have fully enlightened us as regards the present. In my opinion we should work for the benefit of the future, and it would be a good thing to mention in the Summaries drawn up by the Congress the possibilities inherent in the qualities of certain steels for constructional work.

The President (in French). — I thank Mr. ARMAND for his interesting remarks, I should like to know if any other delegate wants to say anything in reply to Mr. ARMAND.

Mr. Guignard (in French). — In reply to Mr. ARMAND's question, it might be stated that the use of rustless steels for construction is very valuable in itself, and makes possible great savings in weight. I am thinking in particular of the State Railways' railcars which are extremely light.

The other side of the question is the matter of repairs. I believe it is difficult to repair parts made of rustless steel, or at any rate much more complicated than repairing coaches and railcars made of ordinary steel.

Perhaps those delegates, who have any experience of rustless steel railcars, could give us their opinions about this subject.

The President (in French). — I should be much obliged if Mr. Picard, who is head of the Rolling Stock and Traction Department of the Western Area of the French National Railways which has some Budd railcars in service, would give us his views on the question of repairing rustless steel railcars.

Mr. Picard, *French National Railways* (in French). — Mr. Guignard's remarks are very much to the point. I do not think that it is possible to repair railcars made of rustless 18/8 steel in repair shops that are merely equipped for ordinary repairs. The repair shops must be equipped with plant similar to that used by the makers; in particular they must have the special spot welding equipment used in the construction of such stock.

In the Western Area we have had several fairly serious accidents with the railcars in question, such as head-on or side-on collisions. In each case the maker had to carry out the necessary repairs by method identical with those used in the construction of the vehicles.

The President (in French). — Are there any other remarks on this question, or any further information to put before the Meeting ?

Could Mr. Turbett give any details about the way repairs are carried out in England and America ?

Mr. Turbett, *Reporter*. — I am in agreement with Mr. Armand about using fabricated sections for coaches, but we do find a great tendency towards corrosion especially with coaches running on coastal services. We have had considerable trouble with these in the past, even with heavy sections.

We have used cold rolled sections, as described by Mr. Armand for some time; we build the coaches in sections, in jigs, the whole is assembled by welding.

With regard to the question of repairing such coaches, it is necessary to set up a suitable repair shop; this, however, does not affect us, because by building them ourselves, we are also enabled to carry out repairs at the same Works.

The President (in French). — As no one else wishes to say anything, I myself should like to add a few words to what Mr. Picard has just said about repairing rustless steel.

During a journey Mr. Armand and I recently made in America, we found that the American railways now repair rustless steel vehicles which have been telescoped, and are consequently seriously damaged on account of a collision. To do so they are obliged to equip some of their shops with all the welding equipment used to make rustless steel vehicles. It can therefore be said that it is now possible to repair rustless steel.

We must now consider how the Special Reporter's Summary should be altered. Taking the text as it now stands, to meet Mr. Legrand's criticism, I suggest deleting the phrase : « By using ordinary structural steels » and beginning with the next phrase as it stands : « By designing all components very carefully, combined with a large use of arc welding. » We might just say « welding » if you do not wish to specify arc welding. « it is possible to achieve very appreciable savings in the weight of coaches » deleting the phrase « reducing the tare to 30 to 35 t. » because, although in France and certain other European countries it has been possible to reduce the tare to 30 or 32 t., it must not be forgotten that in other

countries, such as America, they started with a tare of 70 t. which has been reduced to 50. Consequently the figure of 35 t. does not mean very much.

To sum up, I would suggest omitting the first phrase of the summary, as well as the word « arc », and the final phrase « ... reducing the tare to 30 to 35 t. »

I think this would also meet the wishes expressed by Mr. ARMAND when dealing with the formation of components from sheet worked cold. This would give us the following summary :

« By designing all components very carefully, combined with a large use of welding, it is possible to achieve very appreciable savings in the weight of coaches. »

I think this sums up all the opinions expressed during the discussion.

Any remarks ?

Mr. Venkataraman, *Railway Board, India.* — I wish to raise the point that, regarding the first portion of Summary 2, there is no reference to the use of stainless steel.

The President (in French). — This point will be considered later on. As no objections have been raised, we may take this summary as adopted. I would like to add that after the meeting, we will revise the final wording of the summaries. Now we only want to get some idea of the way they are to be drawn up.

There is a second point to which attention has been drawn during the debate, i.e. the actual construction of the underframe and body.

Should we make any mention in the Summaries of the tendency to adopt the tubular girder form of construction, or at least mention the value of this type of construction ? I would remind you of its value. I think the present tendency is to adopt the tubular girder on all railways.

I suggest the following text for you to discuss :

« Usually » rather than « generally » as I think it is usually « the underframe-body structure is of the tubular girder type which has a high moment of inertia, with the ends specially braced and reinforced to resist shock. »

This meets the points raised just now.

In the same order of ideas, I found certain details given in Mr. GUIGNARD's report regarding static load tests on certain bodies.

I would like to hear the opinions of members of the Section not only on the value of static tests but also on the value of making dynamic tests.

As you know there is now improved equipment available which makes it possible to explore the stresses in coaches; I refer to strain gauges.

Do you consider it necessary to make similar static and dynamic tests on coaches ?

Mr. Guignard (in French). — In Switzerland, the Federal Railways have not carried out any dynamic tests on coaches, but they made a dynamic test without meaning to. I reported this case in my report : a light steel coach ran into a stationary engine at a speed of 60 km. (37 miles)/h. This showed the advantages of the tubular construction, as the covering plates were bent but dit not break.

On the other hand, I was able to see in Italy, on the North of Milan Railway, which also owns some Budd railcars, the results of a collision at 20 km. (12 miles) /h. with a metal coach. The metal coach

had penetrated at least 1.50 m. ($4'11^{1}/_{16}''$) into the Budd railcar. The front part of this railcar can therefore have no strength at all. I think these Railways must be represented, so they might describe their experience.

I believe the Portuguese Railways, from what Mr. Armand has said, also own some rustless steel coaches. It would be interesting to hear the views of the delegates from this Railway.

The Portuguese Railways said they had nothing to report in reply to the questions I asked the various railways. I like to know if this really is the case, or if they could not give us some information now.

The President (in French). — Could the Portuguese and Italian delegates give us any information ?

Mr. Ramalho, *Ministry of Public Works and Communications, Portugal.* — Since 1940, the Portuguese Railway Company has in service 28 vehicles made by the Budd Company of Philadelphia, which have given entire satisfaction.

Some accidents have occurred, not very serious but sufficient to ascertain that repairing is possible in the existing shops providing that the proper means are available, as it is the case.

Lately either in consequence of overloading or defective design some inconveniences have been experienced on the connection of the crossmembers — I think the truck bolsters — to the center sills, but they are being looked after locally by redesign and replacements advised by the makers.

Although I am not in an executive situation within the Company, I am able to give more details, if need be, regarding the behaviour of this material.

I was in the United States on official mission in 1938, before the cars were built, and it was in consequence of information obtained then that the order was placed with Budd.

I have been in that country lately and from actual experience and from what I saw my first good impression is confirmed entirely.

If any railway is going to have cars of this type of construction, it is advisable to have the equipment and the skilled staff to look after them.

The Portuguese Railway Company has provided for it by sending technicians — engineers, foremen and workmen — to practice during the construction of the cars and also by importing some of them dismantled and having them erected in local shops by Portuguese labour.

This procedure proved quite successful and it pays for a considerable number of cars but I am not so sure that it would be so for a small number of cars in service.

The President (in French). — I believe another delegate wishes to say something ?

Mr. Bianchi, North of Milan Railway, Italy (in French). — Mention has been made of the experiences of the North of Milan Railway and the results obtained with Budd vehicles.

Our railway has six of these vehicles and they have had two collisions. It was found very difficult to carry out repairs and we had to send them back to the factory which built them.

There is another matter to be taken into account, and that is the cost of repairs and the high cost of the vehicle itself, owing to the high cost of 18/8 steel.

The latest coaches are now being made of ordinary steel. The old Budd railcars weight 26 t. whereas the new ones in ordinary steel weight 27 t. This difference of only one ton is not sufficient in our opinion to justify the use of special steel.

The President (in French). — We raised the question of tests, and will return later to that of rustless steel. We asked whether or not it was of value to subject coaches to static and dynamic tests, in order to check the stresses on the body and framework of vehicles.

In this connection I reported that at the present time we had the means of carrying out such tests easily.

Mr. Picard (in French). — Up to present tests made on coaches usually involved their destruction. Tests have also been made by subjecting the coaches themselves to considerable forces. All such tests were difficult to carry out. The French National Railways came to the conclusion that it would be very valuable to carry out tests using strain gauges, which would make it possible to obtain more accurate information without great difficulty and without destroying the vehicle.

The President (in French). — Do you see any objection to incorporating in the text of Summary 2 a paragraph to the effect that it is desirable to make static and dynamic tests of the framework, and the use of strain gauges makes it possible to carry out such tests without difficulty ?

Tests during normal running can be made by means of strain gauges placed inside the framework, which make it possible to determine the stresses in the different parts of the body.

Mr. Compton, *Railway Board, India.* — In India we are actually carrying out strain testing of vehicles with electric resistance strain gauges. For impacts up to about 10 m.p.h. the oscillograph records were being obtained. Owing to the difficulty in maintaining the long electric leads from the wagon being tested to the oscillograph it was very difficult to obtain records for impacts of say 40/50 m.p.h.

The President (in French). — If no one objects, we will include this in the final wording of Summary 2.

We now come to Summary 3.

Mr. de Aguinaga (in French). — I should like to point out that Summary 2 refers to ordinary steels, Summary 3 to special steels, and Summary 4 to light alloys.

If you mention ordinary steels in the first summaries there is nothing else to be said.

The President (in French). — The wording of Summary 2 makes no mention at all of the kind of steel. We will mention this in Summary 3. I would remind you that the text of the 1st paragraph of Summary 2 reads as follows :

« By designing all components very carefully, combined with a large use of welding, it is possible to achieve very appreciable savings in the weight of coaches. »

This makes no mention of the kind of steel used, which was discussed incidentally during the debate.

Mr. de Aguinaga (in French). — In Summary 2, I first of all said « By using almost exclusively... » Afterwards we mentioned those steels which, without being special steels, contain certain elements which make them slightly stronger; we thought it best not to be too exclusive and we altered the text a little. We must now decide whether it is question of special steels or not; that is the point.

By special steel is to be understood steels containing certain elements, even in small proportions, not found in ordinary steel as a rule, i.e. manufactured steels.

The President (in French). — Ordinary steel is the usual structural steel, ordinary carbon steel. In addition to this, there are other steels : alloy steel, special steel, rustless steel.

Mr. de Aguinaga (in French). — Agreed. However certain steels are very similar to ordinary steel as only very small amounts of other elements are added and the nature of the steel has not been altered very much. This was why we worded the sentence rather vaguely.

The President (in French). — Summary 2 leaves the question of the kind of steel on one side. In fact the results obtained by « careful design of all parts » might be obtained in the first place by the use of any sort of steel. It is a general statement.

Mr. de Aguinaga (in French). — Obviously.

The President (in French). — In Summary 3 on the contrary mention is made of the different steels : ordinary steels, low alloy steels, rustless and special steels. I think that this will be agreeable to everyone.

Mr. de Aguinaga (in French). — Agreed.

The President (in French). — Will the Special Reporter please read *Summary 3 ?*

Mr. de Aguinaga (in French). — *Summary 3 :*

3. In the majority of cases the use of special steels is limited to a few components, principally in the drawgear and axles. Its use for the framing is limited by the difficulty of welding such work and by the higher costs.

The President (in French). — There are various points which have already been raised during the discussion on Summary 2.

What kind of steel is to be used in the construction ? There are the steels which have been used so far and those which may be used in the future. As far as the present is concerned, the Special Reporter says in the summary we are now discussing : « In the majority of cases the use of special steels is limited to a few components, principally in the drawgear and axles. Its use for the framing is limited by the difficulty of welding such work and by the higher costs. »

I think that the expression « In the majority of cases » is not altogether accurate in view of the fact that as Mr. Armand said just now rustless steel is fairly widely used in America where it is being considerably developed. In Europe, various trials have been made; the French Railways already have some

rustless steel railcars, and the Portuguese and Italian Railways have a few rustless steel vehicles. We cannot say that « the use of special steels is limited to a few components ».

Mr. Armand (in French). — I would like to say something more about this question. I should like to make the matter more precise, and Mr. GUIGNARD agrees with me, so I am speaking as it were for both of us.

The principles inherent in rolling stock construction at a given time have brought us to the point where it seemed desirable to increase the strength of certain parts — buffing, drawgear, axles — and it was felt that with ordinary steel the limit of strength had been reached so that it was desirable to change over to a higher quality and use special steel. We did so, for example, in the case of railcar axles.

The construction of light weight stock is quite a different matter. In this case the method of construction is the essential factor, and in this connection I am entirely in agreement with Mr. GUIGNARD. It is a question of deciding if with the method of construction known in English as « rolled sections » certain special steels have qualities which ordinary steel does not possess.

It is generally believed that special steel is used on account of two properties it has : a greater strength per mm^2, and because it makes possible the use of thinner materials. In my opinion, the greater strength is not the most important characteristic; first and foremost special rustless steel can be bent without affecting its mechanical strength and can therefore be worked cold and used thinner; and then, as it is rustless, it can be used for thin tubular components without any misgivings.

I want to make this quite clear because in my opinion this is the crux of the problem; on the one hand you have the use of special steel to increase the strength of certain components, and on the other the use of a type of construction using rolled sections based on the properties of certain steels.

The President (in French). — I should like to know if anyone wants to say anything about Mr. ARMAND's remarks, or has anything else to say.

Mr. Picard (in French). — In my opinion, the actual mechanical strength of the steel is a very important factor when it comes to choosing between ordinary grades of steel and low alloy steels, or special high alloy steels of great strength. If we go in for rustless steel and insist especially upon the fact that it is rustless, this precisely because it is only used very thin, usually less than 1 mm. ($^3/_{64}$"), whilst low alloy steels are hardly ever used as thin as this even in light weight construction.

Furthermore when low alloy steel with its high mechanical strength is chosen in preference to ordinary steel, the object again is to increase the strength.

The President (in French). — Does anyone else want to say anything about this ?

Mr. Turbett. — I think that the matter of the choice of steel is bound up with the comparative prices of alloy and plain steels; for instance, I do not think that anyone would build bogies and underframes of alloy steel, as it would prove

a most expensive method of construction. On the other hand there are other steel details for which stainless steel is obviously the correct material to use.

Mr. Legrand (in French). — I think we may conclude from these discussions that there are a certain number of obvious advantages in using alloy steels or even 18/8 steels of great strength.

These advantages are :

1) increasing the mechanical strength, and there is no doubt of the advantages of this, otherwise we should be content with ordinary steel. This increase in the strength of the steel is obviously a point to be put on the credit side of alloy and 18/8 steels;

2) decreasing the risk of corrosion, which is an extremely important advantage;

3) and finally as Mr. Armand has insisted at length and very rightly so, the possibility of working some of these steels cold.

Against these advantages there are certain drawbacks :

1) the high cost of these steels;

2) the difficulty of welding some of these steels, which makes it difficult to built up components.

The choice of the steel to be used must therefore depend on a compromise between these advantages and drawbacks. I feel that we should endeavour to make this point clear in our summary.

The President (in French). — Mr. Venkataraman wished to say something just now on the subject of these steels.

Mr. Venkataraman. — We in India have not had large experience of stainless steels. We have a number of coaches running with ordinary alloy steel bodies which have stood up very well. We are very much interested to hear the Delegates speaking from experience of stainless steels and the whole situation of the advantages and disadvantages with the welding of stainless steel. In India it would present considerable difficulties due to not having very skilled staff for welding.

We are considering the use of lightweight stock as a future standard in India and we have certain designs under examination.

We cannot contribute very useful information with regard to the points now under discussion, but we are interested in the information which has been given by the various delegates and we feel that we have benefited considerably by the information given.

The President (in French). — Does anyone else wish to say anything about this question before we draw up the Summaries to be put before you ?

Mr. Armand (in French). — I should like to add for the information of the Meeting that when we raise the question of the qualities to be looked for in structural steels, we should not overlook — as Mr. Legrand stated — the fact that they are rustless, i.e. the resistance of certain steels to corrosion.

In view of the fact that many metal coaches are built of rustless steel whereas no motor cars or buses were made of this material, we asked engineers in the United States whey they did not profit by all these excellent properties in the case of private motor cars as well. The answer, we received was very much to the point : a motor car, whether it be a

private car or a public vehicle, has a life of five years, which does not give the thin sheets time to rust through, whereas a passenger coach has a life of 25 years, so the thin sheets must not rust through before 25 years.

The President (in French). — Any other remarks ?

As no one else wishes to say anything, we will consider the wording of Summary 3. We might say in this summary that up to the present ordinary steel has been used, but there is no reason why rustless steel and alloy steel with a high elastic limit should not be used in the future.

The summary might be worded in this way as a statement of fact, since at the present time only ordinary carbon steels are generally used; if needs be special steels are used for certain components, while rustless steel and low alloy weldable steels with a high elastic limit can be used in construction.

Do you agreed to this formula ?
(Agreed.)

The Bureau will therefore meet this evening to draw up the wording in line with the above.

Mr. Picard (in French). — It seems to me that for the benefit of those members of the Congress who were not present at these discussions, we should indicate the reasons which favour the use of special steels.

The President (in French). — All these reasons will be given in the report of the Meeting. I do not think they could be included in the Summaries without making these too long. *(Agreed.)*

I think that generally speaking it is best to have fairly brief summaries showing actual tendencies in construction without going into details; the latter can be found in the report of these discussions.

If everyone agrees we will submit the new text for Summary 3 at to-morrow's meeting. *(Agreed.)*

Now we will consider *Summary 4*, dealing with the use of light alloys.

Mr. de Aguinaga (in French). — *Summary 4 :*

4. Generally speaking, light alloys have not been applied to the main parts of the framing, but there is on the other hand an extensive field for them in the accessories and fittings. This is not to say that it may not be possible in the future to obtain light alloy framings at an economic figure, but hitherto such as have been built have been experimental, or used to make good a lack of steel.

The President (in French). — The first part of this Summary is a statement of fact; the second deals with the future.

I want to ask you the following question : do you think that light alloys, aluminium alloys, are the materials of the future or not ? The question therefore is the future of light alloys.

I want to know the opinion of the delegates on the future of aluminium alloys. In other words do you think it a good thing to build aluminium coaches or not ?

Mr. Vrielynck, *Reporter* (in French). I suppose this summary only refers to rolling stock for main line railways ?

The President (in French). — Yes.

Mr. Vrielynck (in French). — As far as rolling stock for light railways is con-

cerned, we consider that we have obtained very good results by using frames made of light alloys.

The President (in French). — I would like to point out that at the moment we are only dealing with main line coaches ?

Does anyone want to say anything ?

We should like to know the opinion of the different Administrations on this point, or some of them at least.

Mr. Leguille, *French National Railways* (in French). — Could Mr. Vrielynck tell us whether they have encountered any difficulties in repairing the underframes of damaged coaches ?

Mr. Vrielynck (in French). — No, no difficulty at all; on the contrary, we built these coaches chiefly to make repairs an easy matter. The framework is repaired in the usual way.

Mr. Leguille (in French). — You have then rivetted frame members. What do you do when you have castings on the underframe itself ?

Mr. Vrielynck (in French). — No castings are used on the underframe, only sections which are replaced when they are damaged.

Mr. Legrand (in French). — As regards the point actually raised by Mr. Vrielynck, I fail to see why the use of aluminium should be better or worse for rolling stock on light railways than for standard gauge rolling stock. I cannot see very clearly the reasons why from this point of view the two kinds of rolling stock are built in a different way.

Another point on which I wish to remark concerns the second sentence of Summary 4, in which we make in fact a supposition regarding what will happen in the future, i.e. the possibility of making light alloy framings at an economic figure in the future.

We are all completely in agreement as to the value of using light alloys for the accessories and fittings of coaches. This moreover is one of the reasons why, as has been very well brought out by the Special Reporter in his Report, the saving in weight can be much greater in the case of coaches than in the case of wagons, seeing that in coaches there are many parts for which the use of light alloys results in considerable savings in weight.

As regards reductions in weight to be obtained by the use of aluminium framings, we are more careful not to commit ourselves. No trials have been made so far, and judging by the laconic replies received from the railways, we do not appear to have much recent or detailed information concerning the use of such aluminium framings.

Would it not be better to leave the future alone and be content to report the information we possess concerning the present development of this technique.

Mr. de Aguinaga (in French) .— The future will show.

The President (in French). — Will the delegates please state what they think ?

I would also like Mr. Vrielynck to give us details concerning the strength of the bodies of coaches on his railway.

Mr. Vrielynck (in French). — I think that if only static stresses are considered,

there is no great advantage, perhaps no advantage at all, in using light alloys rather than ordinary steel. However light alloys have a higher coefficient of resistance to bending than ordinary steel, more than double in fact when we take into account the fact that the surfaces are considerably increased.

In the case of rolling stock for light railways, which have to run on the roads, the danger of collisions must be taken into account, especially lateral collisions with lorries. In such cases light alloys have proved stronger than steel. This consideration does not affect main line railways. We find them better from the point of view of repairs as well; they give us flexible parts which stand up to deformation very well.

The President (in French). — Mr. DE AGUINAGA suggests the following text for Summary 4; the first sentence remains unaltered :

« Generally speaking light alloys have not been used for the main parts of the framing, but there is on the other hand an extensive field for them in the accessories and fittings. This is not to say that they may not be used for the framing in the future. »

This is taking the middle path, but I have heard no opinions from users of light alloy coaches. The Swiss Railways use such stock and no doubt Mr. GUIGNARD can give us some information about them.

Mr. Guignard (in French). — We have built 20 such coaches in light alloy for narrow gauge lines. We decided that we could use aluminium for narrow gauge stock in view of the fact that such coaches would be used only on these lines and would not be run in common with other stock.

When these coaches were ordered in 1942, there was such a shortage of steel plates and steel sections in Switzerland that it was impossible to build them of steel. This was why we had to build them in aluminium, when we would have preferred steel coaches. Their cost price is at least 25 % higher than ordinary steel coaches.

These coaches have been in service since 1945 and have given satisfaction. However if we could get the same stock built in steel at a lower cost we should do so. It is a question of finances.

Mr. de Aguinaga (in French). — In the original wording of Summary 4, I said « economically ».

The President (in French). — If I understand the matter aright, the standard gauge railways who have made trials with aluminium coaches did not find them very satisfactory, not even sufficiently so to continue the experiments.

Is this what we are to understand concerning standard gauge railways with main line traffic ? *(Mr. GUIGNARD signified his assent.)*

There remain the secondary railways where other factors come into play which in fact make it possible to use aluminium alloys.

Could we draw up a summary on these lines ? Do you see any objections, Mr. VRIELYNCK ?

Mr. Vrielynck (in French). — We have designed light alloy coaches that behave just as well as we expect a metal coach built of ordinary steel to behave. Our coaches however probably work with much lower tares than those aimed at in

the construction of main line stock. Our figure was not anything like that quoted by Mr. Guignard : 20 to 25 % higher cost; it was 10 to 15 % at the most.

The President (in French). — The requirements to be met by the coaches mentioned by Mr. Vrielynck are not the same as those for standard gauge stock.

Mr. Picard (in French). — Do not customs duties and economic conditions play a great part in the question of price ?

The President (in French). — All the facts must be taken into account in a decision of this kind. I think that in our summaries which are mainly technical and not economic, we should confine ourselves to technical considerations.

To conclude, Gentlemen, to-morrow morning we will submit the revised wording of this summary according to the opinions expressed during the discussions, namely that on standard gauge lines, in the case of main line traffic, light alloy construction is not of great interest, though it may be of value in the case of light railways.

Does the Special Reporter agree ?

Mr. de Aguinaga (in French). — Yes.

The President (in French). — I will try to send every delegate present a copy of the revised text. Then we can discuss it at to-morrow's meeting.

During this second meeting, we will finish the discussion on passenger stock and then consider goods wagons. I would then like to say a further word about passenger stock and consider the question of bogies and their new methods of construction.

— The Meeting adjourned at 12.5.

Meeting held on the 26th June 1947.

Mr. A. PARMANTIER is in the Chair.

— The Meeting began at 9.40 a.m.

The President (in French). — Gentlemen, we will now continue to discuss Question II.

Summaries 1, 2, 3, and 4 relating to *passenger rolling stock*, about which we seemed to be in agreement yesterday, will be submitted to you in their revised form.

We will then discuss other points in connection with passenger rolling stock and goods wagons.

When the discussions are finished, I suggest that we adjourn for half an hour, so that the « Bureau » can revise the wording of the Summaries. I will then read the revised text for your approval and comments.

We will now resume the discussions at the point where we left off yesterday. We have considered the first four Summaries.

Before we go on to Mr. de Aguinaga's 5th Summary, I think it would be of value to formulate a summary concerning

the reduction in weight of bogies. All the Reporters dealt with this, so I think it would be a good thing to mention it and say — if the Meeting agrees — that the bogies have been lightened at the same time as the bodies, and in this way it has been possible to maintain at least the same standard of comfort as formerly.

The suggested summary reads as follows; it will be the *new Summary 5* :

Summary 5.

« The lightening of bogies can be obtained in particular by replacing laminated springs by helical springs or the use of torsion bars controlled by shock absorbers. Designs already in use allow comfort to be maintained or even increased, whereas lightening the body alone and keeping the ordinary heavy type of bogies might reduce it. »

Has anyone any remark to make or anything further to say on this subject ?

Mr. **Hug**, *Catalan Railways* (in French). — Mr. President, Gentlemen, there is one point which has not yet been mentioned either generally nor in connection with the matter with which we are now concerned, and that is the use of rubber.

As regards the bogies, since this is the subject that we are now discussing, I would like to state at once that it is asserted that the use of rubber combined with springs in the suspension — there are various methods in use — improves the comfort.

In addition, during recent years, certain tramways and light railways have made use of the widely used principle of suspended wheels in which there is a rubber washer between the weel centre and the axle, a principle which can also be used in certain cases for main line railways.

As far as I have been able to discover the SAB wheel, of Swedish origin, is the one that gives the best results. For a great many years many of the trams in Switzerland, in Zurich in particular, the largest tramway system, have been fitted with these wheels, which are coming in general use. In Switzerland, they are made by the Fischer Works, at Schaffhouse.

It is not possible however to use rubber in this way where there are long gradients. On long gradients the tyres and wheel centres would be overheated by the application of the brakes, which would lead to trouble, but on railways where there are no long gradients, this method of suspension has undoubtedly given excellent results both from the point of view of the maintenance of the stock and of comfort, and I think it would be interesting to take this process into account in certain cases.

The President (in French). — There is no doubt that the use of rubber plays a great part in improving comfort.

I should like to have the opinion of other delegates on this point, as well as on the use of rubber suspended wheels which it cannot be denied do improve comfort.

Mr. Turbett. — We have had very considerable experience in England over many years with a combination of rubber and steel bearing springs, and large numbers of our main line stock has been running with this combination.

With regard to wheels with rubber cushioning or tyres, we have had no ex-

perience in England. In any case, I do think that better results in the lightening of the bogies themselves will be obtained by the use of fabricated methods of manufacture in place of castings, and this is what is being done on most British railways at present.

Mr. Guignard (in French). — I do not think that rubber has been used in place of laminated springs on the railways covered by my report; rubber has merely been used as an accessory in the suspension, for example between the springs and the spring seats, but does not actually form part of the suspension. I do not know if any trials have been made in this connection.

As for rubber suspended wheels, the Swiss Federal Railways have not got any on their standard gauge stock, but a trial is under consideration with a 28 t. light steel coach, which is to be fitted with rubber suspended wheels, not SAB wheels but some designed by Messrs. Pirelli. These can be used for much heavier axle loads than are found on tramways.

Mr. Legrand (in French). — From what has been said, it seems to me that the speakers have been inspired by two aims : improving the comfort and lightening the weight.

Gentlemen, I believe the question we are now discussing is more particularly the lightening of stock. The arrangements mentioned by Mr. Hug are very interesting. The use of rubber, and in particular the use of rubber suspended wheels, is more closely connected with the question of comfort than weight reduction. On the other hand the replacement of castings by formed sheets mentioned by Mr. Turbett is closely connected with weight reduction.

Consequently in my opinion if what has been said is to be taken into account in the Summary suggested by the President, it would be more in order to mention the use of pressed sheets than the use of rubber devices.

However, since the text includes the words « in particular » so that it does not exclude the use of devices other than those mentioned, I am in favour of the adoption of this wording as it stands.

The President (in French). — Weight reduction must not be made at the expense of comfort. Consequently at the same time as the weight is reduced, steps must be taken to assure that the standard of comfort will at least be maintained. This is why personally I have no objection to mentioning the use of rubber in the suspension as well as springs in the Summaries.

Mr. Vrielynck (in French). — I would like to know if any delegate present has any knowledge of trials carried out with wheel centres made of light alloys ?

Dr. Nichols, *Railway Board, India*. — It would seem that rubber would be best employed for damping out high frequency vibration to which the body is particularly sensitive, while the lower frequency at greater amplitude vibration could be more suitably dealt with by the employment of the usual forms of steel springing.

Mr. Hug (in French). — In connection with Mr. Legrand's remarks, I would like to point out that as far as rubber suspended wheels are concerned, it is not only a question of comfort, but

also of the unsprung weight which plays a great part in the life of the stock. The unsprung weight in the case of the wheels I mentioned is of the order of 200 kgr. (441 lbs.) and includes hardly no more than the tyres.

The President (in French). — At the end of the meeting, we will submit a wording taking into account the various remarks made, in particular those concerning the use of rubber in the bogies and wheels. This will I think meet the wishes of the delegates. *(The Meeting signified its agreement.)*

Mr. de Aguinaga (in French). — *Summary No. 5 (now No. 6).*

5. The economic advantages expected from the use of light weight coaches have not yet been definitely determined, owing to the short time such stock has been in service, which means that the results are not noticeable as yet as regards costs of haulage and maintenance of the permanent way. Most Managements, however, consider that the benefit obtained should be very appreciable.

The President (in French). — I would like to know whether you think the matter of this summary does not call for certain observations.

Mr. Hutter, *French National Railways* (in French). — Mr. President, I should like to be allowed to say a word although since I belong to the Commercial Department I am not able to keep up my end in technical discussions with this assembly of engineers.

I should like to say a word because I believe the traffic men also have something to say regarding the economic side of the question and the value of weight reduction.

There are two ways of reducing the weight of coaches : the first is to lighten the trains without increasing their capacity, i.e. improve their performance, which is of great value in the case of mountain railways, whereas on level lines, especially with electric traction, it does not appear to be so interesting.

The difference in performance between trains weighing 400 t. and 500 t., a considerable difference in weight, is practically nil from the traffic point of view.

The second method is to increase the size of trains whilst keeping their weight constant, which leads to great savings since it makes it possible to carry the same number of passengers with fewer locomotive-miles.

It must not be forgotten that this policy only leads to real savings if the number of services is reduced. It is therefore closely connected with the question on the agenda for Section III.

There is however a third method which consist in profiting by this lightening of the rolling stock to make simplifications or reductions in weight or savings in the engine power. However, from the traffic point of view, we are of the opinion that apart from the usual weight reduction which costs nothing, any true weight reduction is costly. The question should therefore be considered as a whole, so that we can see what weight reduction really means. As far as passenger trains are concerned, the output is certainly high, but the other side of the picture must not be forgotten; on level lines for example the mere fact of offering additional seats to carry the same amount of traffic with the same number of services is certainly one of the most expensive ways of increasing the comfort.

The President (in French). — I thank Mr. Hutter for his remarks.

Mr. Hutter (in French). — We traffic men would perhaps find it more valuable in many cases to have coaches with a shorter life so that they would not get out of date.

The President (in French). — That is completely outside the scope of the question now under discussion.

If there are no other remarks on this Summary 6, I suggest the following text which agrees entirely with the Special Reporter's summary :

« 6. Lightweight rolling stock has been in service too short a time and in too small numbers to give any definite results as to its advantages both from the points of view of economy and savings in wear on the permanent way but certain advantages do appear to be apparent. »

(Agreed.)

This wording is therefore adopted, and we will now consider the *Summaries relative to goods wagons.*

GOODS WAGONS.

Mr. de Aguinaga (in French). — *Summary No. 1 :*

1. There is a tendency to endeavour to reduce the weight of goods wagons, while at the same time increasing the carrying capacity, both as regards weight of load and volume, and ability to travel at higher speeds.

The President (in French). — I would like to ask the Meeting if it considers that the following sentence : « at the same time increasing the carrying capacity both as regards weight of load and volume, and ability to travel at higher speeds » should be included in a summary dealing with the lightening of rolling stock.

Capacity as regards weight and volume is quite a separate question. If the stock is reduced in weight, the capacity can be increased, but they are separate matters.

Mr. Hutter (in French). — Here again I think you should hear the point of view of the traffic man.

It is a much simpler matter for goods wagons than for passenger rolling stock, as there is no question of performance or appreciation. Lightening goods wagons necessarily increases their load since the best output is obtained by the maximum load per axle and any reduction in weight must be used to increase the number of wagons, or to be more exact, the useful tonnage hauled by the train. There is no question of anything else; there is no question of improved performances but simply improving the cost price. As a result the advantages and disadvantages of lightening the stock can be accurately gauged. There are certain disadvantages ; increasing the useful tonnage of the trains slightly increases transport delays and slightly lengthens the turn round. This does not appear very serious to me.

As for the economies, these have been calculated fairly accurately on the French National Railways. When we calculated the cost price, for transport in an open wagon, the original wagon had a useful load of 20 t., and a tare of 10 t., i.e. the standard wagon of the French National Railways and other railways, for 250 km. (155 miles), the total cost as at December 1946 was approximately 1.35 fr. per useful t./km. According to this figure

the part cost price was about 0.68 fr., or approximately one half.

By reducing the tare by one ton, we obtain a saving of approximately 2.5 centimes per useful t./km., so that if the tare is reduced by one ton, which is a reduction of 15 %, a figure now considered possible technically, if the wagon makes 150 journeys a year, there is a saving of 7 500 fr., taking the December 1946 figures.

This gives a very clear idea of the total cost which can be justified in lightening a 20 t. wagon by 15 %.

I am no engineer, but I believe this excludes highly involved methods of construction and limits the lightening of goods wagons to a large extent to what can be done by simple methods of construction, i.e. cheaply.

With this reservation, we agree with the desirability of having wagons which make possible a low cost price, since commercially these are of greater value.

In the case of a 20 t. open wagon, we have a yearly sum of 7 500 fr. which can be divided amongst 5 000 fr. higher first cost and 2 500 fr. higher maintenance costs, for example. It is this which fixes the limits of weight reduction; beyond it nothing is gained.

Mr. de Aguinaga (in French). — The idea in my mind when I drew up the Summaries was simply to condense in a few lines the tendencies I observed in the reports as a whole. It seemed to me that there was a tendency to reduce the weight, and also a tendency to increase the load and volume carried, and I wished to report this.

The President (in French). — Exactly. I simply want to know if, when considering the question of lightening goods wagons, we should draw up Summaries...

Mr. Hutter (in French). — The two things are completely complementary.

The President (in French). — Not from the technical point of view. We design wagons to meet the requirements of the traffic department.

Mr. Hutter (in French). — Perhaps in this case it would be better to proceed in another way; the traffic department should make their requirements known and be told what this involves.

The President (in French). — If you agree, we will go back to this question later on. For the moment it is leading us too far from the point at issue.

What the Special Reporter said was correct, I do not dispute the statement; I only wanted to know if it should be included in the Summaries.

I should like to know the opinion of the delegates on the question of deciding whether the Summary is to be left as it is or not ?

I would like to add one word in reply to Mr. HUTTER; at the present time the traffic department is asking us to reduce the capacity of covered wagons. It must not be say therefore that there is a general tendency to increase the carrying capacity.

Mr. Legrand (in French). — As the Reporter has just said, what he has endeavoured to state in his Summary is purely and simply a statement of fact, without prejudice to future possibilities.

At the present time is it or is it not correct to state that the Administrations

are endeavouring to lighten their goods wagons ? I think that the present tendency is in general to lighten them whatever may be the consequences as far as the operating is concerned. We hope they will prove fortunate as far as the load on the track, etc., is concerned.

Consequently, I readily agree with the President's suggestion, i.e. that we should state purely and simply the fact which emerges from Mr. de Aguinaga's report, which is that the railways are endeavouring to lighten their goods wagons as much as possible.

The statement at the end of point I concerning the improved running conditions, seems to me somewhat different from the idea of weight reduction; I would prefer a summary worded as suggested by the President.

The President (in French). — Does everyone agree to the following wording :

« 1. Railway Administrations are endeavouring to reduce the weight of their goods wagons as much as possible. »

(Agreed.)

As regards points 2 and 3, I would like to split these up as we did yesterday when it was question of passenger stock, in order to make two new Summaries, one of which would deal chiefly with the construction of goods wagons and the other with the metal used in their construction. The wording would be the same as that suggested by the Special Reporter, only set out differently.

The text of Mr. de Aguinaga's *Summaries 2 and 3* is as follows :

2. Reduction in weight is being obtained chiefly by using arc welding in the building up for the body framings and the underframes, and as a rule ordinary class steels only are used for the sections, generally of rolled pattern but in a few instances pressed up.

The use of light alloys for the main framing is still in the experimental stage.

3. For the sheathing of the bodies and subsidiary items, such as doors, brakesmen's shelters, etc., light alloys would appear to offer economic advantages, as does a wide use of pressed plating for uprights and other members, which contributes considerably to their rigidity.

I will now read you the new wording of *point 2* :

« Reduction in weight is being obtained chiefly by using welding in the construction of the body framing, underframes and bodies, as well as by the use of pressings which permits of reducing the thickness whilst maintaining sufficient rigidity. »

This is to indicate the present tendency in the lightening of our stock.

Do you wish to begin discussing this second point concerning the principles of construction of lightened goods wagons ?

Has anyone any remarks to make about the wording and the principles laid down therein ?

Mr. Compton. — If the underframe is treated as a separate structure you save just as much weight by building in high tensile steel rivetted together as by the use of low carbon steel : that is our experience.

The President (in French). — I think that the general tendency, on most railways, I will not say on all railways, nowadays is to use welding as much as possible, quite apart from the kind of metals used.

In my opinion nearly everyone is in agreement on the use of welding; is this

correct or on the contrary should it be modified ?

Mr. Leguille (in French). — I think the President is quite correct. According to what I have seen both in France and abroad, the tendency is indeed to use welding. In the case of wagons however we often come up against the question of equipping the factories or shops which have to maintain wagons as well as build them. As was said yesterday in the case of coaches, a wagon with a welded body can only be repaired by welding. The shops that have to do the repairs must be equipped for this and it is perhaps that condition which has delayed the faster generalization of construction welding.

Mr. Cuypers, *Belgian National Railways* (in French). — Mr. President, I should like to add a few words to what Mr. LEGUILLE has just said.

On the Belgian Railways, we recently ordered 10 000 wagons which are now under construction. These 10 000 wagons will all be welded. We have insisted that our suppliers should be properly equipped for this work. The Belgian National Railways have also taken the necessary steps to train workmen and supervisory staff in welding so that they are quite competent to undertake welding repairs.

Mr. Guignard (in French). — In the Summary suggested by the PRESIDENT, there occurs the word « pressings » which I do not like very much. Would it not be better to say « pressed or formed sheets » ?

The President (in French). — If you like.

Mr. Guignard (in French). — I think that there are two chief ways of reducing the weight of goods wagons :

1) using welding instead of rivetting;

2) using pressed or formed sheets to some extent in place of sections, since such sections have to a large extent, though not entirely, disappeared in the case of passenger stock, while in goods wagons some of them are being replaced by formed sheets.

I think these are the two essential factors in reducing the weight of goods wagons.

The President (in French). — Perhaps instead of « is being chiefly realised » we should say « is generally realised » which would satisfy Mr. COMPTON.

The wording might be as follows :

« 2. The lightening is achieved in general by the use of welded construction of the underframe members and bodies and also by the partial use of pressed or formed sheets which permits of reduction in thickness whilst maintaining sufficient rigidity. »

(Mr. GUIGNARD signified his assent.)

— *This wording was adopted.*

The President (in French). — *Point 3* concerns the materials used in the construction of wagons.

Here is the wording I suggest :

« 3. Ordinary steels are normally employed in the construction of goods wagons.

« Light alloys are sometimes used for certain details. Experiments are being carried out with light alloys for the principal framing. »

Has anyone anything to say about this wording ?

Mr. Picard (in French). — I have no observations to make, but I would like to hear the opinion of certain delegates about the question of the freedom from corrosion of certain metals used in the construction of wagons.

Certain Administrations have carried out trials on a fairly extensive scale with so-called rustless steels of ordinary commercial grade (copper alloy steels and other similar steels). As far as I know these trials were not satisfactory. In practice such steels did not prove to be any better than the ordinary grade steels. I should be very glad if certain members present at the meeting would give their personal opinion on this subject.

Mr. Ward Smith, *South African Railways and Harbours*. — The only experience we have had was with coal hopper wagons of 50 tons capacity, where we used copper bearing plates. We found, as a result, that there was no appreciable gain over the normal wear over ordinary mild steel plate and in consequence from an economic point of view we have not continued with the use of copper bearing plates.

Mr. Cuypers (in French). — Mr. President, this is what we found when repairing metal coaches covered with copper alloy steel plates, which were seriously damaged during the war.

We had to dismantle the framing and we found that near the opening of windows with sliding panes where no lead had been used to collect the water, there was serious corrosion. This only affected the sections, the covering plates had stood up in a very satisfactory way.

The President (in French). — The Americans use Corten steel with a copper content of 0.3 to 0.5 for coaches.

A Delegate (in French). — And 0.15 of phosphorus.

The President (in French). — If you see no objection, we will adopt Summary 3 as I read it.

Mr. Perrig, *Swiss Executive Organising Committee* (in French). — I have no objection to make, but would like to point out in this connection that we carried out some trials, not with underframes but with the hulls of boats. After cleaning the ordinary steel sheets with a sand jet, we sprayed on a layer of zinc and this gave very good results. We did not find any signs of corrosion on one hull after more than 16 years in service.

The President (in French). — We will therefore consider Summary 3 as agreed, and pass on to *Summary 4*.

Mr. de Aguinaga (in French). — *Summary 4 :*

4. The reduction in weight normally obtained in goods wagons is rather less than that obtained with passenger stock, being round about 15 % for ordinary designs.

Nevertheless, by using light alloys almost throughout it is possible to achieve still greater savings in weight, but so far only experimental designs have been made like this.

The President (in French). — Have you anything to say about this summary or do you agree to it ?

Mr. Legrand (in French). — I quite agree with the wording suggested by the Special Reporter, but I do not know if it is absolutely necessary to mention a figure of 15 %. It would be better to define this a little more and explain in

relation to what this saving of 15 % can be obtained. I am of the opinion that we should make a qualitative not a quantitative statement.

The President (in French). — We might say :

« The possible saving in weight with goods wagons is relatively lower than in the case of passenger stock. »

This is a statement of fact, without mentioning the figure of 15 %.

Mr. de Aguinaga (in French). — I included it as a matter of information.

The President (in French). — It all depends on the weight with which we start. In some cases it might be 15 %, in other 10 % or 20 %.

Mr. de Aguinaga (in French). — If you think it serves no useful purpose we can leave it out.

The President (in French). — I see no objection.

A Delegate (in French). — There are the words « is about ».

Mr. Guignard (in French). — I think we must be logical. We did not give any figure in the case of passenger stock, so why should we for goods wagons ?

Mr. de Aguinaga (in French). — In the Summaries about passenger rolling stock I put 30 to 35 tons, but this detail was deleted.

The President (in French). — « 30 to 35 tons » only applied to certain European railways, but not to the American railways.

Mr. de Aguinaga (in French). — I gave it as an example; otherwise we express opinions but have no standard of comparison. If however the Meeting prefer to delete it...

The President (in French). — I will do whatever the Meeting wants.

Mr. de Aguinaga (in French). — That is my sentiment too.

The President (in French). — I should like to hear the opinion of delegates on this subject.

Mr. Guignard (in French). — If no figure is given in the case of passenger coaches, none should be given for goods wagons.

The President (in French). — Will those in favour of retaining the figure of 15 % please put up their hand ?

Seven delegates put up their hand but the *majority were of the opinion that the figure of 15 % should be omitted, so it was deleted.*

The President (in French). — Do you agree that the wording of the last paragraph concerning the use of light alloys should be left as it is ?

Mr. Daubresse, *Belgian National Light Railways* (in French). — Though we are in favour of using light alloys for the framework of passenger coaches, there are, we believe, good reasons for not using them in the case of goods wagons.

As was stated yesterday when dealing with passenger stock, I believe that the first thing to be considered when endeavouring to reduce the weight is the general arrangement of the suspension.

Logically, we think that in order to make the best possible use of the metal, it is of value to keep it subjected to uniform stresses in tension and compression, by designing the framework in such a way that it will stand up to these stresses, giving it for example the form of a trellis girder, like the Americans, the longitudinals being supported by stiffeners.

I think that in this case the possible behaviour of light alloys compared with steel, even ordinary steel, makes the use of such alloys of little value.

The President (in French). — Perhaps there is a solution that will satisfy everyone and that is to suppress the last paragraph.

Mr. de Aguinaga (in French). — I agree.

Mr. Legrand (in French). — If I understand aright, the President just now suggested adding the following phrase to point 3 : « Light alloys are sometimes used for certain details. Experiments are being carried out with them for the principal framing. » Consequently, the introduction of this second sentence in point 3 seems to me necessarily to lead to the suppression of the last sentence of point 4. I think therefore that we should suppress the last sentence of point 4 and keep the two sentences in point 3 which state solely and simply that light alloys are used for certain details and experimentally for the main framing.

There is no doubt from the information supplied by the Reporter Mr. Guignard that light alloys are used on certain railways for wheel centres. I think in consequence this statement might be kept.

Mr. Guignard (in French). — In the case of passenger stock.

Mr. Legrand (in French). — On the French National Railways, we have carried out a trial with goods wagons. I think this is a statement of fact.

The President (in French). — Under these conditions, if no objections are raised, *Summary 4* will merely consist of the following sentence :

« 4. The possible saving in weight with goods wagons is relatively lower than in the case of passenger stock. »

Does everyone agree ? *(No remarks.)*

This Summary is therefore adopted.

If you agree, we will now adjourn the Meeting for half an hour.

Mr. Martin, *Indochina Colonial Railways* (in French). — Although the question as set does not embrace economic considerations, in the part dealing with passenger stock we had a final summary dealing with the economic results.

Just now Mr. Hutter told us that from the commercial point of view, the economics of the question differ in the case of goods wagons and passenger stock. It is possible that the weight of goods wagons has not been reduced for economic reasons.

I think that at the end of the part dealing with goods wagons we should do as we did in the case of passenger stock and add a short paragraph dealing with economic considerations.

The President (in French). — What do you suggest for the wording ?

Mr. Martin (in French). — I would suggest saying that economic and com-

mercial considerations may hinder the progress of lightening goods wagons.

The President (in French). — I really don't think that is the case.

A Delegate (in French). — We might say « may limit ».

Mr. Picard (in French). — Reduction in weight may be of little financial value.

The President (in French). — We could say « too extensive a reduction in weight ». Weight reduction is quite a normal practice. But it must not be carried too far if it is to be of value economically.

Mr. Martin (in French). — From the point of view of weight reduction, goods wagons are behindhand in comparison with passenger stock. There is no doubt that this is due to economic reasons, as the traffic department has less need of light weight goods wagons than light weight passenger coaches.

Mr. Guignard (in French). — In the case of goods wagons, the weight reduction concerns the tare, which is merely a fraction of the useful load. For example take an open wagon weighing 10 t. and takes a load of 20 t. These 10 t. represent only half the useful load. Now a reduction in weight of one ton, i.e. 10 % of the tare compared with the weight of the loaded wagon represents only 3.3 % In the case of passenger coaches, the tare is predominating, as it is 4 to 8 times as much as the useful load. There is therefore more interest in lightening passenger rolling stock than goods wagons.

Mr. Legrand (in French). — I agree with Mr. MARTIN that there is no reason for treating goods wagons differently from passenger stock in the Summaries. The value of weight reduction in both cases is only real up to a certain point. After a certain point, the additional cost cannot be recovered from the operating point of view.

The question therefore is to decide if we should introduce a final paragraph in the Summaries concerning goods wagons, or — which perhaps I should propose — if we should suppress this point in the case of the passenger stock.

There is no doubt, as Mr. HUTTER's remarks made clear, that the question of weight reduction is a delicate one from the point of view of the operating results, both in the case of goods wagons and passenger stock. It would seem, moreover, that the benefits in the case of goods wagons are less than in the case of passenger coaches.

The final point of the Summaries concerning passenger stock stated that these benefits seemed of the utmost importance. In the case of goods wagons, we should state a somewhat contrary fact, namely that these benefits are not very important.

I think it might be better to leave both these statements out and say nothing at all, neither in the case of passenger stock nor goods wagons.

Mr. HUTTER said that he was going a little beyond his role of a traffic man, and I wonder if we are not going somewhat outside our role of technicians when we start mentioning balance sheets. It is our job to discover the benefits of a reduction in weight for which the traffic men are asking.

The President (in French). — I would like to add a word.

We discussed the question of passenger stock at length in order to agree the Summaries and it would not be advisable to return to the matter. Consequently I would like to know if we could not add the following sentence to Summary 4 as already agreed :

« The reduction in weight should not be developed beyond a point where it is not *a commercial proposition.* »

(Marks of assent.)

The President (in French). — I suggested adjourning the Meeting, but as we have agreed all the points concerning goods wagons, I think it would be better to go over each of the Summaries concerning passenger stock in turn, the new wording of which was distributed to you all this morning, and see if everyone agrees the final wording.

— *The Summaries concerning* Passenger Stock *(Nos. 1 to 6) as given further, were then read. No remarks were made.*

— *In the case of* Goods Wagons, *Summaries Nos. 1, 2 and 3 were agreed without remarks, while after Summary 4 had been read, the following exchange of ideas took place.*

The text adopted during the discussion was worded as follows :

« 4. The possible saving in weight with goods wagons is relatively lower than in the case of passenger stock.

« The reduction in weight should not be developed beyond a point where it is not of economic value. »

Mr. Legrand (in French). — We thought of saying in this final paragraph :

« The reduction in weight should not be developed beyond a point where it is not *a commercial proposition.* »

A Delegate (in French). — I think that a distinction should be made between the tare on the one hand and the loaded wagon on the other, since if the tare is too low, the weight of the loaded wagon is considerably less. This is what Mr. Guignard said just now.

The President (in French). — We are only speaking of the tare.

A Delegate (in French). — Then we should add « as regards the tare ».

Mr. de Aguinaga (in French). — It does not seem necessary to me.

A Delegate (in French). — In the case of passenger stock, the tare weight is practically the same as the weight of the coach when loaded, to within a few tons, whereas in the case of goods wagons there is a difference in weight in the ratio of 1 to 3.

The President (in French). — Gentlemen, we are now agreed as to the amended form of the second paragraph of Summary 4, suggested just now. *(Agreed.)*

Before the Meeting ends, I should like to thank the Reporters and the Special Reporter for the interesting reports presented to the Section.

I should also like to thank the Delegates who were good enough to take part in the discussions, thereby enabling us after exchanging views to formulate these interesting summaries. *(Applause.)*

— The Meeting ended at mid-day.

DISCUSSION AT THE PLENARY MEETING

Meeting held on the 27th June 1947.

DR. W. MEILE, PRESIDENT, IN THE CHAIR.

GENERAL SECRETARIES : MR. P. GHILAIN AND DR. G. DREYER.

ASSISTANT GENERAL SECRETARY : MR. EYRE A. W. TURBETT.

Mr. Ghilain, *General Secretary.* — We now come to Question II which was considered jointly by Sections II and V, the Summaries for which were published in the *Daily Journal of the Session*, No. 4, for the 27th June.

— *The reading of these Summaries did not give rise to any observations.*

The President. — We will therefore consider the Summaries for Question II as adopted.

Summaries.

A. Summaries relative to passenger rolling stock.

« 1. There is a general tendency towards reducing the weight of all metal passenger stock without adversely affecting strength or comfort.

« 2. Whatever the quality of the steel used it has been possible to reduce, by a large proportion, the weight of passenger stock by careful design of all parts and by the use of sections made of thin sheets welded together.

« Usually the underframe-body structure is of the tubular girder type which has a high moment of inertia and the ends of which are specially braced and reinforced to resist shock.

« Static and dynamic tests of the underframe-body structure are considered desirable. The use of strain gauges for such tests is most suitable.

« 3. Ordinary carbon steel is still most generally used for building passenger stock. However, the use for that purpose of weldable low alloy steel with a high elastic limit, as well as the use of rustless steel, is becoming more common.

« 4. Light alloys can be widely used for many detail sections and for interior fittings.

« They are also used in the building of structure assemblies on passenger stock of some light railways, but on main line railways their use for that purpose does not seem likely to be developed.

« 5. The lightening of bogies can be obtained to some extent by using welded or rivetted thin plates for underframe construction and by replacing laminated springs by helical springs or the use of torsion bars controlled by shock absorbers.

« It is also interesting to mention the combined use of rubber and steel for main suspensions and the use of rubber suspended wheels.

« Designs at present in use allow for « increase in comfort and it would be « possible to further reduce the weight « of the vehicle by replacing the heavy « bogies in present day use.

« 6. Lightweight rolling stock has been « in service too short a time and in too « small numbers to give any definite re- « sults as to its advantages both from the « point of view of economy and savings « in wear on the permanent way but « certain advantages do appear to be ap- « parent. »

B. Summaries relative to goods wagons.

« 1. Railway Administrations are en- « deavouring to reduce the weight of « their goods wagons as much as pos- « sible.

« 2. The lightening is achieved in gen- « eral by the use of welded construction « of the underframe members and bo- « dies and also by the partial use of « pressed or formed sheets which per- « mits of reduction in thickness whilst « maintaining sufficient rigidity.

« 3. Ordinary steels are normally em- « ployed in the construction of goods « wagons.

« Light alloys are sometimes used for « certain details. Experiments are being « carried out with light alloys for the « principal framing.

« 4. The possible saving in weight « with goods wagons is relatively lower « than in the case of passenger stock.

« The reduction in weight should not « be developed beyond a point where « it is not a *commercial proposition*. »

[625 .143 .3 (.73) & 625 .144 .4 (.73)]

Testing with Magnaflux on the D. & R. G.W.,

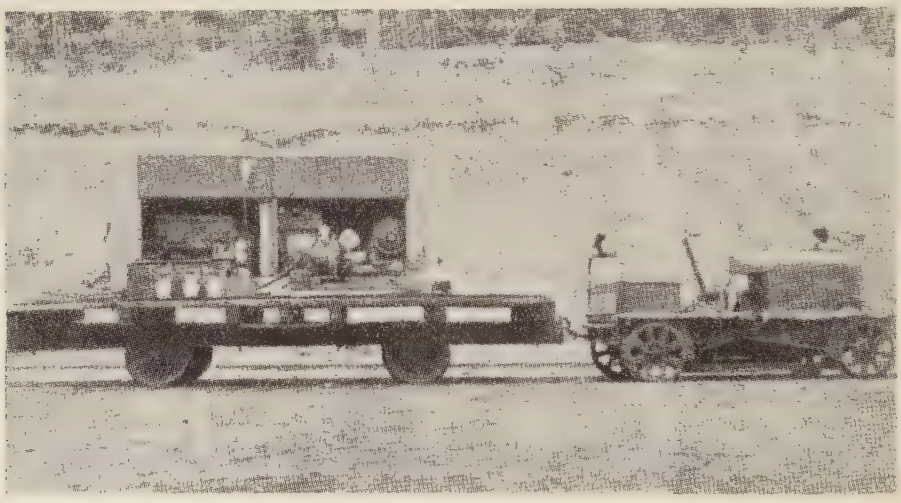
by Ray McBRIAN,

Engineer of Standards and Research Denver & Rio Grande Western.

(Railway Engineering and Maintenance, February 1947.)

Considerable use is being made on the Denver & Rio Grande Western of Magnaflux, and similar aids, for testing purposes in maintenance of way work. The parts being tested include rails, joint bars, welded joints, track tools, chains and others. Incipient defects, mostly of a surface nature, are being detected in time to permit the defective parts to be removed from service or repaired before the danger point has been reached. Magnaflux, to put it briefly, is a means of testing by which the part to be tested is magnetized and then sprayed with a special powder which is drawn to, and accumulates along, the length of discontinuities present.

For testing rails, joint bars and welded joints, as well as certain other track parts, we use a portable trackmounted inspection unit, consisting of a General Electric 40-volt, 300-amp. generator set, driven by a Waukesha gasoline engine. The unit is mounted on a push car and is pulled by a standard motor car. Included as an essential part of the unit is a small generator set capable af driving two portable grinders or power brushes.



The portable track-mounting unit used in Magnaflux testing on the D.&R.G.W.

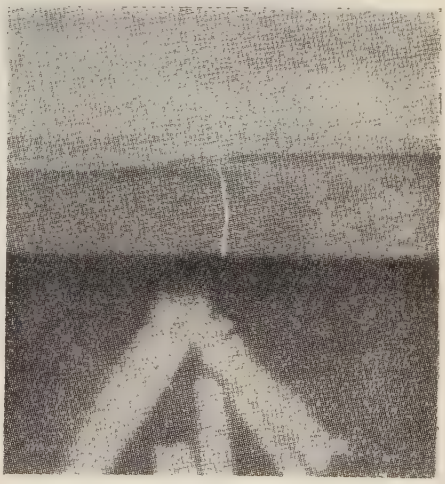
One of the purposes for which we have used the portable outfit is the testing of welded joints in the Moffatt tunnel. This tunnel is 6.2 miles in length and contains approximately 1 900 joints. When the joints in this tunnel were first

welded some years ago, the older type Thermit weld was used, which required the drilling of a hole in the end of each rail to permit the use of a clamp for pulling the rail ends together during the welding operation. Due to steam operation in the tunnel corrosive conditions are severe. Because of alternating

Typical indication, as obtained by Magnaflux of a crack in the top surface of a joint bar.

abrasive and corrosive action about $^1/_8$ in. of metal is lost from the running surface each year. With the original welds it was found that, when the head of the rail had been worn down a certain distance, the stress in the webs around the holes was increased to a point where stress-corrosion cracks were produced. Defects in some of the welds were also observed.

When these defects were first noticed it was decided to determine their nature and severity by means of the portable Magnaflux unit. All the welds and bolt holes were inspected and the information obtained was used as a basis for determining whether the rails should be replaced. The method of inspection, using the portable unit, was to send the current through the rail in the vicinity of the weld and around the bolt holes, and then blow the powder on with a hand bulb, after which the holes as well as the joint welds were observed at the same time. A few years ago new rail was placed in the tunnel and was welded by a later-type Thermit weld that does not require the drilling of a hole in the web of the rail. No inspection problems have been encountered to date with these welds.



This crack, found in a rail on a curve, indicates the presence of a compound fissure.

Testing joint bars.

Another application of the portable unit was the testing of the joint bars in a five-mile section of track. These bars were of the controlled-bearing type, and the reason for inspecting them was that some breakage was being encountered and it was desired to determine the nature and severity of the problem. The cracks causing the breaks were originating at the top bearing surfaces at the ends of the rails and were progressing downward. Using the portable track

inspection unit, all the bars in the five-mile section were tested out-of-face, being removed from the track for this purpose. All of those found to have shallow cracks were ground, when this was found to be necessary, with the portable grinder to remove the cracks, and then replaced in the track. Those that were found to have cracks that were too deep for treatment in this manner were taken made. When it is considered that frequently these crossings are not disturbed for a period of two or three years after a general overhauling, it is apparent that the dictates of safety require that any defects present be found at the time the crossing is open for inspection. When such defects are found with the portable unit the rails are renewed. Formerly it was the practice to butt weld the joints in

The presence of this web crack was brought out by Magnaflux. Most such cracks, because of the bleeding of the metal, can be seen by the track forces.

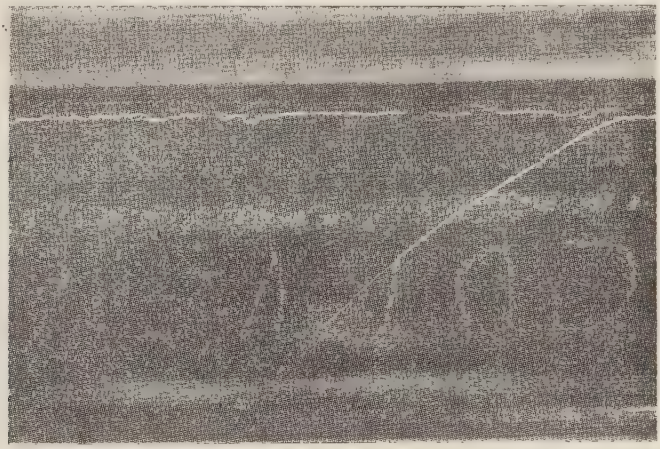
to the shop where they were slotted and welded and then ground so as to form a small easement on the top bar surface, after which they were replaced in service.

Rails at road crossings.

It is also our practice to use the portable unit for testing the rails in road crossings at certain locations for bolt-hole cracks. This work is usually carried out in cities where there are a large number of road crossings and is done during the summer when repairs are being made at such crossings. Some of the bolt-hole cracks encountered at such locations are large enough to be seen by eye, but others were found to be just starting at the time repairs were being certain crossings, using an early oxyacetylene method without subsequent heat treatment, but after a considerable number of cracks had been found in such welds with the aid of a portable testing unit the practice of butt welding rails in road crossings by this method was discontinued.

We have also used Magnaflux in testing rails in open track for defect under certain conditions. The regular testing of rails on our road is done with Sperry detector cars which are usually operated in the spring and fall. However, after the passage of the detector car, and during the intervals between tests, we have encountered problems arising from rail failures, and for this reason we consider it necessary to have Magnaflux equipment available for detecting rail defects.

Several years ago during the winter we encountered particular trouble with rail failures in mountain canyons on six-degree curves. These failures were produced by the cracking out of defects known as compound fractures These defects develop rapidly and result in sudden fractures. For inspecting such rails in track we use a portable device, operated by one man, for magnetizing the rails. Another man follows with a bulb to blow the Magnaflux powder on the rail. One of the illustrations shows a crack-out in the head of a rail, which was located in this manner. In one instance a total of 13 rails was removed from a curve following an inspection made in this manner, with as many as three crack-outs being found in one rail.



Fillet cracks such as these were found by Magnaflux and their cause revealed by Stresscoat.

Finding head checks.

A somewhat similar problem in inspection to which we have also applied Magnaflux is that of detecting head checks in rail. Although this problem may not be common on some railroads it is on ours because of the heavy grades encountered in the mountainous territory that we serve. Head checks comprise a defect that the electrical method of inspection sometimes does not detect. They seem to occur only in certain locations where the track is elevated for fairly high passenger-train speeds, but where large mountain freight locomotives, operated at relatively low speeds, cause excessive loads to be imposed on the gage-corner side of the low rail. Using the portable hand inspection unit we can determine the depth and width to which the head checks have progressed. When the depth has reached a certain amount we know that the rails are in danger of failure and they are, therefore, removed from service.

As an aid in carrying out the various inspection problems encountered by our track forces we have placed a portable Magnaflux kit in the hands of all our track inspectors and all roadmasters. The plan eventually is to send such kits to all section forces. This unit consists of a tin box containing an Alnico magnet, a rubber bulb with a spray head,

and a can of Magnaflux powder. In some cases where web cracks have developed the Alnico magnet and the Magnaflux powder have been used to bring them out. However, most cracks of this type can be seen by the track inspection forces due to the bleeding of the metal.

What about fillet cracks ?

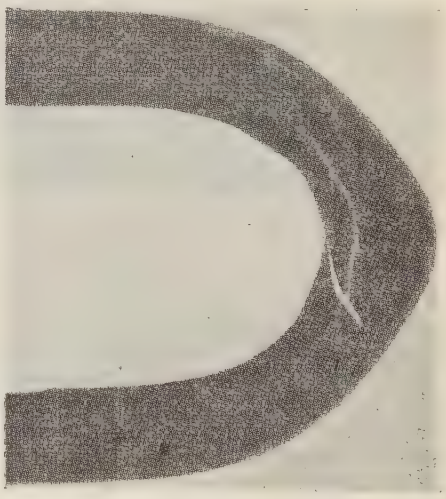
A special problem that has arisen on our railroad during the last several years, which has been solved with the aid of Magnaflux and another testing means that will be described later, is presented by the development of fillet cracks on the high sides of curves in rails only three to four years old. These cracks, some of which were located with the aid of Magnaflux, have occurred at random locations in the rail, and were not continuous. Their presence could not be explained at the time by any condition of the track or by the particular location of the rail in the curve.

To determine the cause of these cracks we employed a procedure involving the use of a product known as Stresscoat. This is a coating that is applied to the surface of the object under test. The nature and approximate extent of the stresses in the object are indicated by the action of the coating. For instance, if the object is loaded in compression, a flaking action will occur in the Stresscoat, while, if it is loaded in tension, cracks will appear in the coating at right angles to the direction of the applied load.

Tests were made with the Stresscoat at four different curves. Both sides of three rails on the high side of the curve were sprayed with the material and installed in each curve. For a 24-hr. period the rails were then examined after the passing of every train. It was found that on curves of 3 deg. and over, on which the speed of certain locomotives was restricted to 45 m.p.h., the operation of these locomotives at a speed in the neighbourhood of 55 m.p.h. caused a compression flaking of the Stresscoat in the fillets on the field side of the outer rail and the formation of tension cracks in the fillets on the opposite side. The magnitude of the stresses thus indicated is shown by the fact that a stress of 65 000 lb. per sq in. in compression was required to produce the flaking of the Stresscoat that was noted in the outside fillets of the rails.

Inspecting track tools.

Another application in which Magnaflux is being used to good advantage on the D.&R.G.W. is the inspecting of track tools for defects. The program for doing this calls for inspecting all new tools

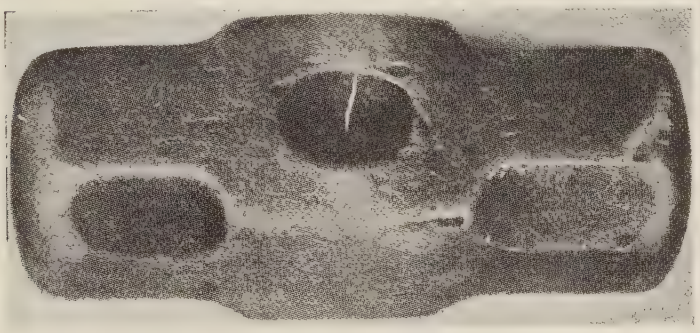


Showing defects found by Magnaflux in a chain link.

as they are received; of all reclaimed tools, both before and after reclaiming; and of all tools in use on a periodic basis. The latter inspection was undertaken at the request of our safety department as the result of injuries occurring because of defective tools. For making

the inspections the portable testing unit is used, being turned over to the roadmasters and track inspectors for this purpose at intervals.

Regarding the inspection of reclaimed tools, it is our experience that many blacksmiths will try to reclaim tools almost regardless of their condition. This is economic waste, and to prevent it we have established the practice of inspecting such tools before they are reclaimed, and discarding those that are in bad condition. For the purpose of inspecting tools both before and after reclamation we have installed a small tool inspection unit in our research laboratory.



Showing defects found by Magnaflux in a sledge hammer.

Defects in chains.

Still another application of Magnaflux on our road, which was also instituted at the request of the safety department, is the periodic testing of all the chains used by the maintenance, car, mechanical and freight-handling departments. This form of inspection was undertaken as a result of a number of accidents including damage to materials being handled, caused by defective chains. The plan is for each chain to be inspected every six months, being sent for this purpose to the nearest shop having a Magnaflux testing unit. The procedure is to wrap the magnetizing cable around the chain and then blow the powder on. Any defects found of a transverse nature causes the chain to be automatically scrapped.

The testing of so-called electric-welded alloy chains presents something of a special problem. On inspecting new chains of this type an indication is sometimes obtained at the electric welds when actually there is no defect. By cutting several of these open and making a study of them we have been able to establish a standard of what is acceptable and what is not, and have acquainted our Magnaflux operators with these findings. In other words, the successful testing of such chains requires that the operator have a background of knowledge and experience on which to base his judgment. Incidentally, an important aspect of all use of Magnaflux is the ability to make a proper interpretation of the findings.

[621 .131 .1]

The development of locomotive power at speed.(*)

(The Railway Gazette, April 11, 1947.)

The mean effective pressure in a locomotive cylinder can readily be calculated for any given steam conditions, valve events, and clearance, assuming only the back pressure during exhaust. The calculated mean effective pressure is independent of the speed, so that the indicated horsepower derived from it would be directly proportional to the speed. In practice, the mean effective pressure falls as the speed increases, and it is this increasing deviation from the ideal which may limit the power of the locomotive as effectively as the capacity of the boiler.

Progress in fifty years.

Fifty years ago, the attenuation of the indicator diagram at express speed was so great and so variable as to render any conclusions to be drawn from calculated mean effective pressures of purely academic interest.

To-day, the rate of deviation of the mean effective pressure with increase of speed still varies widely, and is the most important characteristic of the engine, but in the best designs it has been reduced to such an extent that an analysis such as that attempted in the first part of the paper, of the relationship between mean effective pressure and the boiler pressure, cut-off, and clearance, together with the corresponding cylinder efficiencies, becomes of great practical importance, especially in designing locomotives for the relatively higher pressures now being adopted.

With the paper, are basic data graphs giving calculated mean effective pressures for all steam pressures from 120 lb. per sq. in. to 320 lb. per sq. in., and over the whole range of economical cut-offs from 5 per cent. to 50 per cent. They also give the data for percentage clearance spaces from 5 to 15 per cent. The relative efficiencies are plotted over the same range of boiler pressures and cut-offs for 5, 10 and 15 per cent clearance respectively.

These curves show that, with the same clearance, it is necessary for a locomotive with a boiler pressure of 250 lb. per sq. in. to be worked at effective cut-offs from 20 to 30 per cent. of the stroke shorter than a locomotive with a boiler pressure of 180 lb. per sq. in., in order to maintain the same relative cylinder efficiency. In other words, if a locomotive with a steam pressure of 250 lb. per sq. in. is normally worked at the same effective cut-off as a locomotive with a pressure of 180 lb. per sq. in., say, 15 per cent. cut-off at full speed, the relative cylinder efficiency will be 7 per cent. less.

In view of the fact that the corresponding Rankine cycle efficiencies for the two pressures are 20.3 and 18.4 per cent. respectively, this means that the effect of the reduced expansion ratio nearly nullifies the gain in efficiency due to the higher pressure, the respective cylinder thermal efficiencies being 17.3 and 17.0 per cent.

Owing to the effect of clearance, it is theoretically impossible under normal running conditions at speed to realise

(*) Abstract of a paper presented by Mr. E. L. Diamond, M.Sc. (Eng.), A.M.I.Mech.E., to the Institution of Mechanical Engineers on February 21.

the higher cylinder thermal efficiencies associated with higher steam pressure, as compared with locomotives of lower boiler pressure equipped with modern valve gears permitting early cut-off working, unless compound expansion is adopted. It should be said that boiler pressures have been increased primarily in order to increase the power obtainable within the limits of the prescribed loading gauge and axle weight; but any limitation of efficiency is likewise a limitation of power.

Another graph completes the basic data by giving the steam consumption per indicated horsepower-hour over the full range of steam pressures and cut-offs for 5, 10 and 15 per cent. clearance respectively. These graphs present the net effect of the changes in opposite directions of the Rankine efficiency and the relative efficiency respectively.

Dalby's straight-line law (*) for the deviation of mean effective pressure

$$p = c - bv$$

where c and b are constants for a particular engine and cut-off, implies that the mean effective pressure falls steadily to zero.

With superheater engines, at any rate, this is contrary to experience. Curves for mean effective pressure are plotted for a diverse and representative range of locomotives in the paper, and the plotted points, generally, show a rapid drop from the calculated mean effective pressure in the initial stages and tend to straighten out later.

Such curves correspond to a simple exponential law, the diminution of mean pressure being proportional to some power of the speed of revolution less than unity :

$$P_n = P_c - kN^{1/x}$$

where P_n is the mean effective pressure at N r.p.m., P_c is the calculated basic mean effective pressure read from the graph, and k is a constant characteristic of the particular locomotive. Trial and error showed that $1/x$ does not vary greatly over the whole range of curves, and that the error involved in taking as a mean the square root of N was generaly within the scatter of the points.

It was also found that k is a fairly constant proportion of P_c for any particular engine, so that the equation of the curves reduces to the convenient form

$$P_n = P_c \left(1 - \frac{1}{k} \sqrt{N}\right)$$

The value of k in this equation is shown for every curve plotted, together with the mean value in the form of a « characteristic power equation » for each locomotive, on the diagrams.

Estimating power at speed.

This equation not only gives more accurate results over a wide range of speed for superheater locomotives than Dalby's law, but is a more accurate guide in estimating the power at speed of a projected design than either Cole's constants or the Kiesel formula, with its illogical basis in the boiler, provided appropriate values of the constant k are taken. Each designer can establish such values fairly closely from indicator diagrams from his own previous designs, but for general use the following values are suggested :

Type of engine.	
Simple-expansion with short-lap valve gear, piston or slide valve	25
Simple-expansion with long-lap valve gear, piston valves	45
Simple-expansion with modern design of poppet valves and steam passages of maximum section	75
Compound locomotive with short-lap valve gear, piston or slide valves	30
Compound locomotive with long-lap valve gear, piston valves	50
Compound locomotive with modern design of poppet valves and steam circuit of maximum section	80

(*) Proc. Inst. C.E., 1905, vol. 164, p. 329.

The value of P_c may be read directly from the curves in the paper, but the method will give greater accuracy if the value is calculated exactly for the point of compression appropriate to the particular valve-gear design adopted. The assumed exhaust pressure of 18 lb. per sq. in. abs. must not be modified, however, as this would alter the basis of the constants. The higher the value of k, that is, the more nearly horizontal the mean pressure curve and the shorter the cut-off, the more necessary is it that P_c should be accurately determined.

Dalby's law involved two constants, neither of which could be used independently as a criterion of performance. The advantage of a single constant is obvious, but since it has to accommodate two different classes of loss, namely, the pressure drop during steady flow between boiler and valve gear, and the complex cyclic losses between valve gear and atmosphere, any abnormal relationship between the two will be shown up by the fact that no value of k will give a curve conforming with the mean line through the observed values of mean effective pressure.

If, on the one hand, the drop of pressure in the steam chest is relatively small, but the steam distribution is bad, the slope of the plotted points will be steeper than the exponential curve given by the characteristic power equation, and will, in fact, conform more nearly to Dalby's straight lines. On the other hand, if the valve gear gives a good steam distribution, but there is an excessive pressure drop through the superheater and main steam pipes, or excessive clearance, then the exponential power curve will be steeper than the mean slope of the observed mean effective pressures. Examples of both kinds of abnormality are given in the paper.

Abnormal losses.

In well-designed locomotives such abnormalities generally do not occur, and the characteristic power equations fit closely the observed values of mean effective pressure over the normal range of speed. It may be reasonably claimed, therefore, as an additional advantage of this method of plotting characteristic power curves, that it shows up at once such abnormal losses.

To determine the value of k, and hence to plot these curves, a value of mean effective pressure P_n at a speed of, say, $N = 250$ r.p.m., should be adjudged as falling on the average line through the available data for a particular cut-off. (One observed value only can be taken if no others are available, though the scatter of the points in the diagrams in the paper shows that this may give misleading results.) The value of k is then given by

$$k = \frac{P_c \times \sqrt{N}}{P_c - P_n}$$

P_c being read off from curves of calculated mean effective pressure in the paper.

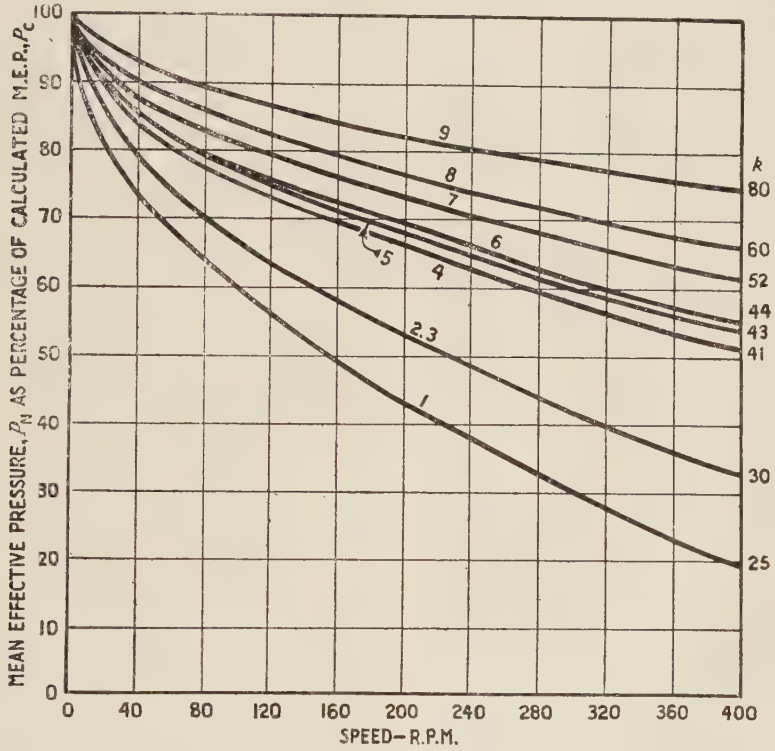
It is sometimes found that the value of k for very short cut-offs differs considerably from the average value for other cut-offs. Such abnormal values should be ignored in determining the characteristic power equation because (*a*) no locomotive is designed to give maximum power at the shortest cut-offs, and (*b*) the probable error in evaluating P_c increases with short cut-offs, mainly on account of the increase in the proportion of clearance steam.

The characteristic power equation gives the mean effective pressure, and hence the power at any speed *for a particular cut-off*. The reason why other proposed power formulæ have been related to the boiler is to eliminate this condition, and to give the maximum horsepower of which the locomotive as a whole is capable, or the power at a specified rate of evaporation.

The author contends that this is fun-

damentally wrong in principle. The first section of the paper shows how greatly the economy of the engine is affected, provided the steam distribution is good, by the relationship of cut-off pressure he is using. The data in the paper will facilitate such determination.

The logical procedure, therefore, is to state the power of the locomotive at that specified cut-off, and to design the boiler



Mean effective pressure curves for various locomotives on truly comparative basis

The values of k in the characteristic power equation for each locomotive are given alongside the corresponding curve.

1. Midland 4-4-0 superheater locomotive (1917).
2. Original P.O. compound superheater Pacific locomotive (1909).
3. Pennsylvania K4S locomotive in original form.
4. Pennsylvania K2A locomotive.
5. Pennsylvania E6S locomotive.
6. L.M.S. rebuilt « Royal Scot » locomotive.
7. Pennsylvania K4S locomotive rebuilt with Franklin poppet valve gear.
8. Rebuilt P.O. compound locomotive No. 3705 (Chapelon).
9. Pennsylvania T1 locomotive with Franklin poppet valve gear.

and clearance to boiler pressure. The good designer will choose the dimensions of his engine to enable it to give the maximum continuous power required at an economical cut-off for the steam to supply sufficient steam to feed the engine at that cut-off at the highest contemplated speeds, taking a maximum rate of evaporation appropriate to the design of the boiler, and not a fixed and

universal figure as was the practice of the German State Railways.

Assessing test results.

The coefficient k also offers a criterion whereby the test results of a completed locomotive may be assessed. Thus, the accompanying diagram shows the performances of all the representative locomotives referred to in the paper on an *absolutely comparative basis* by plotting the mean effective pressures as a percentage of the calculated mean effective pressures. Comparative curves of mean effective pressure on a speed basis have frequently been published in recent years as a percentage of boiler pressure. Such curves, however, are not comparable, even if they are for the same nominal cut-off, because, as is shown in the first part of the paper, the percentage of the boiler pressure attainable as mean effective pressure without loss will vary with the boiler pressure and clearance for the same nominal cut-off.

It is important to emphasise, however, that k is not a direct index of thermal efficiency, but rather of the power-weight ratio at high speed, which for railway operation is considerably more important. Such a coefficient derived from test results also should be related always to the designed characteristics of the locomotive, as these are subject to practical limitations which the designer has to take into account. A high value of k, for instance, is not necessary for shunting or banking engines.

The relationship of the coefficient k to the relative cylinder efficiency is of some interest in connection with the use of the data curves for steam consumption as a basis for boiler design. Comparison with published test results shows that the *minimum* recorded steam consumptions are remarkably close to the figures given by the data curves for optimum conditions, except for early locomotives, like the Midland engine of 1917, which have a low value of k. Even under conditions of relative inefficiency, as at late cut-offs, agreement is good if allowance is made for the difference between nominal and effective cut-off.

Test plant data, however, show that at any particular cut-off the steam consumption may vary by over 25 per cent. due to various causes, especially varying steam temperature and leakage, and that, generally, it is higher, the lower the speed. Moreover, in practice the condition of maintenance of a locomotive has an overriding effect on steam consumption, leakage being a principal factor. A margin of at least 30 per cent. must, therefore, be allowed over the minimum consumption given by the data curves.

[621 .133 .1 (.42)]

Conversion from coal to oil burning

(From *The Locomotive, February 15, 1947*)

Having referred in an editorial article to the principle of oil burning, we now propose to deal with some of the practical considerations.

The Great Western Railway propose to alter 172 locomotives, comprised as follows : 63 2-8-0 class 28xx; 84 4-6-0 « Hall » class; 25 4-6-0 « Castle » class. These are in addition to the 44 engines (25 « Castles », 1 « Hall » and 18 2-8-0 tender and tank) already converted under the Company's own scheme to which reference has already been made in « The Locomotive » — *vide* page 178, Vol. LI. Fuel depots are to be installed at Old Oak Common, Reading, Didcot, Swindon, Bristol (Bath Road), Bristol (St. Philip's Marsh), Newton Abbott, Newport (Ebbw Junction), Cardiff, Landore, Gloucester, Westbury, Banbury and Plymouth (Laira). These installations are in addition to those already existing at Llanelly and Severn Tunnel Junction. The work is being pressed forward as materials become available.

The L.M.S.R. intend converting 485 engines, those selected being : Class 5 4-6-0 mixed traffic 5; class 4 0-6-0 16; class 7 0-8-0 175; class 7 2-8-0 11; class 8 2-8-0 245; 2-6-6-2 Garratt 33. The work is being carried out at Crewe, Derby and Horwich. The engines concerned will be employed on heavy freight duties and fuelling facilities will be available at Cricklewood, Willesden, Bletchley, Northampton, Nuneaton, Crewe (South), Shrewsbury, Bath, Wellingborough, Toton, Nottingham, Kirkby, Westhouses, Staveley, Hasland, Leeds, Normanton, Wakefield, Rose Grove, Mirfield, Farnley Junction, Newton Heath, Aintree, Lostock Hall, Swansea and Carlisle (Kingmoor).

The L.N.E.R. programme covers 450 locomotives made up of Ministry of Supply and class O1, O2 and O4 2-8-0's; J 39 0-6-0's; K 3 2-6-0's and Q 6 0-8-0's. The numbers of each type are still to be confirmed. Oil depots will be at Heaton, Newport, York, Carlisle, St. Margaret's, Temple Mills, Doncaster, March, Peterborough, Hornsey, Annesley, Colwick, Woodfort and at each main Works.

The Southern scheme provides for the alteration of 110 engines consisting of 20 « West Country » class; 16 N 15 and H 15 classes; 34 N and U classes; 10 D 15 and 30 L 11 and T 9 classes. The work of conversion will be carried out at Eastleigh and Ashford. Oil storage facilities are to be provided at Eastleigh, Exeter and Portsmouth.

The London Passenger Transport Board has decided to convert Neasden generating station to oil firing and has commenced the work involved.

Neasden has 6 pulverised fuel boilers, the first of which was due for conversion to oil burning before the end of 1946. The remaining five will follow and will be completed in not less than 18 months. It is estimated that when all these boilers are converted they will consume some 45 000 tons of oil a year. When the scheme is complete oil will be delivered from Purfleet in trains of twenty 10 ton tanks and each train load will be transferred, in approximately 8 hours, into two 1 600 ton storage tanks; when full these will contain 4-5 weeks' supply.

The Ministry of Supply is providing all the necessary equipment for the conversion of locomotives and has placed an order with The North British Locomotive Co. Ltd., for 1 192 sets of equip-

ment including firepans, brickwork, firedoors, manifolds, steam and oil piping, valves, etc. In addition 715 oil tanks complete with heaters have been ordered from that Company, others will be supplied by Dockyards and Royal Ordnance Factories.

The President of the L.M.S.R. has recently stated that the cost of converting the 485 engines to be altered by his Company will be in the region of £900 000.

The burning of oil in this country is not a new departure, as our readers will be well aware, in fact much pioneering was done here by Holden on the Great Eastern Railway. Later others tried oil but rather by way of a temporary expedient. The Great Western were first in the field in this new conversion scheme and they have rendered invaluable assistance by their conventional enterprise — to which tribute has been paid by the Minister of Fuel amongst others.

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NORLIN (P. V.). — **Angelot welded locomotiv** (2 300 words & fig.)

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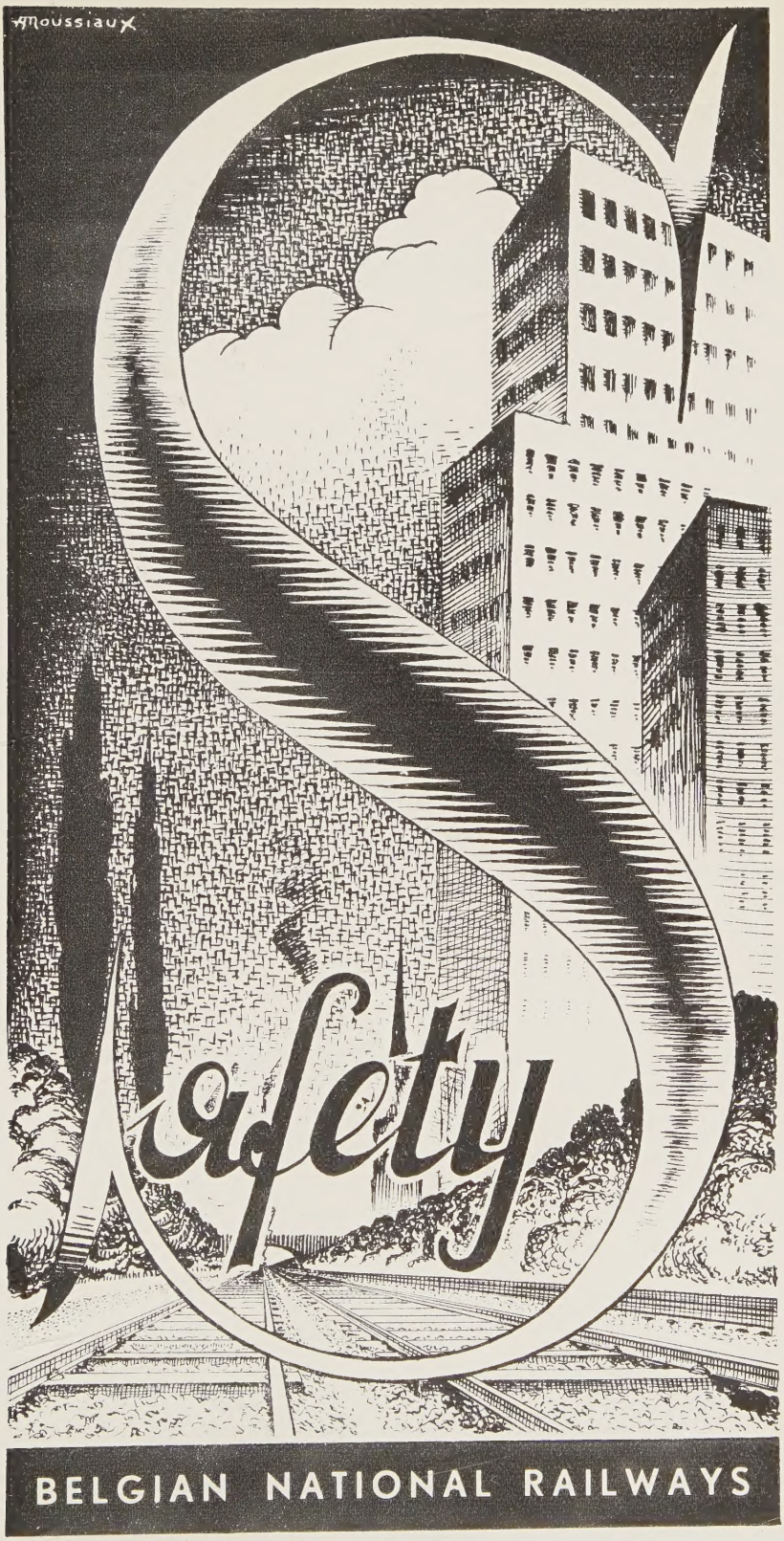
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